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# **TRADITIONAL FOOD SYSTEM, SELF- RATED HEALTH, AND MENTAL WELLNESS IN GREENLAND**

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# ABSTRACT

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The Arctic is undergoing sociocultural and environmental changes that are threatening the traditional food systems of local communities. Importantly, those systems are in the heart of Indigenous cultures contributing to the health and well-being of communities and individuals. Simultaneously, traditional food of northern Indigenous peoples is associated with health concerns related to the accumulation of contaminants and unfavourable nutritional profile.

Previous research has primarily focused on the objective indicators of health in relation to traditional food systems of Greenland, whereas much less is known about the effects on subjective health and well-being. In turn, this thesis focuses on the local peoples' own perspectives concerning their traditional food system and builds on the existing knowledge and providing an additional viewpoint on the topic. The overall aim of this thesis is to characterise the contemporary role of the traditional food system and related changes, and examine the relationship between the traditional food system, self-rated health, and mental wellness among the local people within one community in Greenland.

The data were collected as part of an international, multidisciplinary research project Nunataryuk in a form of a survey, from west coast of Greenland. A total of 100 adults participated in the study. The survey included questions related to subsistence activities, use of traditional food, their importance, and related changes observed in the community. Also, the survey provided information on the aspects of subjective health and mental wellness. The data were analysed using mainly quantitative methods, including crosstabulation and logistic regression.

The results of this thesis suggest traditional food system to still have an important role in the community where the level of traditional food consumption and reliance on subsistence activities remain high regardless of the ongoing sociocultural and environmental changes. Additionally, the traditional food system seems to contribute to the self-rated health and mental wellness of the local people. Neither the concerns over potential health risks nor the potential benefits related to traditional food consumption did come out in the results of this study. However, the subsistence activities and related changes had clearer, somewhat contradictory, impact on the subjective health and mental wellness. Hunting and fishing seemed to be beneficial in terms of mental wellness, whereas gathering was associated with lower self-rated health. In turn, a decrease in the number of berries and mushrooms was negatively associated with mental wellness.

This study provides insight of the local peoples' own perspectives regarding the role of traditional food system and its impacts on their health and mental wellness. Further research is needed to gain deeper understanding on the matter. Moreover, these perspectives should be included in the policymaking concerning traditional food systems and related changes.

Key words: traditional food system, Indigenous people, self-rated health, mental wellness, subsistence activities, traditional food, environmental contamination, dietary transition, Greenland

The originality of this thesis has been checked using the Turnitin OriginalityCheck service.

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## ABBREVIATIONS

AMAP	Arctic Monitoring and Assessment Program
CVD	Cardiovascular disease
DDE	Dichlorodiphenyldichloroethylene
FAO	Food and Agriculture Organization
OCPs	Organochlorine pesticides
OECD	Organisation for Economic Co-operation and Development
PCBs	Polychlorinated Biphenyls
PFAS	Per- and polyfluoroalkyl substances
POPs	Persistent organic pollutants
PUFAs	Polyunsaturated fatty acids
SDWG	Sustainable Development Working Group
SLiCA	Survey of Living Conditions in the Arctic
SRH	Self-rated health
UNEP	United Nations Environment Programme
WHO	World Health Organization

## 1. INTRODUCTION

The Arctic is undergoing various changes and facing unprecedented challenges, including environmental threats resulting from warming of the climate and environmental contamination (Arctic Monitoring and Assessment Program [AMAP], 2017b, 2019) as well as sociocultural changes further shaping the epidemiological profile of communities with Indigenous and non-Indigenous residents (Kuhnlein et al., 2013; AMAP, 2018b), henceforth referred to as “local” communities. The term “Indigenous” is capitalised throughout this thesis as a sign of respect and recognition as well as to be consistent with other larger global community of specific demographics, for example, Europeans, whereas “Indigenous peoples” is used to refer to separate Indigenous populations (JHR, 2017; UBC, 2021).

The environmental and sociocultural changes have a major impact on the lives of the Indigenous people around the Arctic (Berner et al., 2015) in accordance with the One Health approach and holistic Indigenous worldview, which both acknowledge the interconnectedness of the health of the environment, wildlife, and people (Gibbs, 2014; Hueffer et al., 2019). Indeed, traditional food systems encompassing aspects such as subsistence activities, nutrition, food and water security, social relations, cultural importance, and connection with nature, are in the heart of Indigenous cultures and contribute to the health and well-being of Indigenous communities and individuals (Kuhnlein et al. 2009; Kuhnlein et al., 2013), and are threatened by the ongoing changes and related challenges faced around the Arctic (Berner et al., 2015).

Additionally, traditional food of northern Indigenous peoples contains numerous contaminants, including persistent organic pollutants (POPs) and heavy metals, especially mercury (AMAP, 2018a). The accumulation of these contaminants in the Arctic is a major concern in relation to the health and well-being of the wildlife as well as the local communities, especially the Indigenous people, also in Greenland (Kuhnlein et al., 2013; AMAP, 2015; Weihe, Debes, et al., 2016; AMAP, 2018a). Moreover, the traditional Greenlandic diet relies heavily on fat and protein with very restricted use of fresh fruits and vegetables and therefore, is different from the current dietary recommendations of a healthy diet provided by WHO (2020). However, traditional food systems have also

substantial economic, cultural, nutritious, social, and health benefits (Kuhlein et al., 2009; Kuhnlein et al., 2013; AMAP, 2017a). This paradox of simultaneous health risks and benefits associated with the use of traditional food of Indigenous people in the Arctic is referred to as the “Arctic dilemma” (AMAP, 2015, p. 111). Importantly, previous research has indicated differences in the levels of contamination, human exposure to contaminants, and related adverse health effects in the Arctic region (see for example, AMAP 2015, 2018b).

Extensive body of research (see for example, AMAP, 2015; Weihe, Debes, et al., 2016; AMAP, 2018a, 2018b) explores possible adverse health effects of contaminants and unfavourable nutritional profile of the traditional diet of Indigenous peoples in the Arctic. Moreover, the possible beneficial health effects associated with the traditional food systems are also well established (Kuhnlein et al., 2013). However, much less is known about the Indigenous peoples’ own perspectives in relation to their traditional food systems and possible health risks and benefits associated. This thesis aims to explore the contemporary role of traditional food system in one community in Disko Bay region in Greenland and, moreover, to examine the relationship between different aspects of traditional food system, related changes, and subjective health and mental wellness among the local people in Greenland. The term “local people” is used in the context of this study as no information on the ethnicity of the respondents was gathered and thus, the study population may include both Indigenous and non-Indigenous people residing in that particular community. The data were collected as a part of an international research project Nunataryuk in a form of a survey, from a town on the west coast of Greenland. A total of 100 adult local people participated in the study. The survey included questions related to subsistence activities, use of traditional food, their importance in the community, and observed changes in relation to the traditional food systems. Additionally, the survey provides information on the aspects of subjective health and mental wellness that encompasses subjective well-being, satisfaction with life, quality of life, and feelings of empowerment.

The results of this thesis provide information on the contemporary role of traditional food system and strengthen the understanding of its importance in a rural community undergoing sociocultural transitions and environmental changes. Moreover, the results

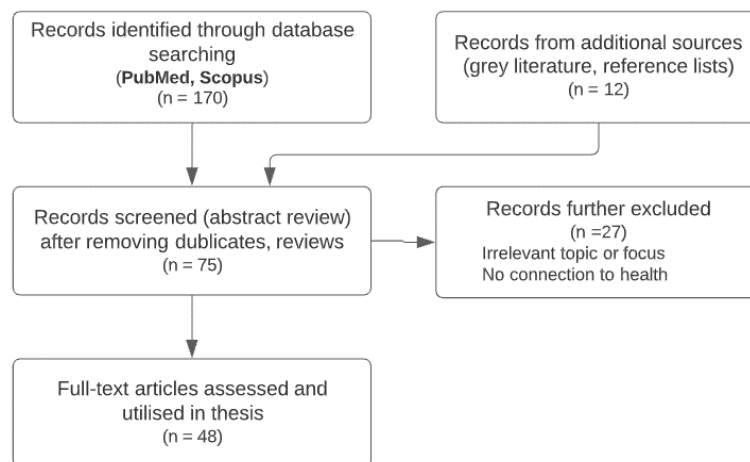
add new insight on the association between the traditional food system and self-rated health (SRH) and mental wellness in the community; a perspective often lacking from the existing research tackling the conflicting evidence on traditional food systems in Greenland.



## 2. LITERATURE REVIEW

This literature review consists of two major parts: first, an overview of essential concepts and theories relevant to the topic, without strict search limitations (chapters 2.1 to 2.5), and second, more in-depth analysis of recent research focusing on the health implications of traditional food system in Greenland (chapters 2.6 to 2.8). The literature searches concerning the latter focused on identifying studies measuring health outcomes in relation to traditional food systems in Greenland by using search terms “food, nutrition or diet”, “subsistence activities, fishing, hunting, gathering or wild harvesting”, “Inuit or Indigenous peoples”, and “health or well-being” with regional limitations to Greenland, excluding articles published prior to 2010. The screening process is illustrated in Figure 1 below.

**Figure 1.** Modified PRISMA flow diagram of literature review process of studies measuring health outcomes in relation to traditional food systems in Greenland.



After, the remaining 48 articles were categorised according to their focus and divided into themes identified in the literature in relation to traditional food systems and health in Greenland. These categories are discussed in detail later. Furthermore, reviews, reports, and older but significant studies were used throughout the literature review to provide additional information and provide perspective as well as in case of lack of more recent studies or studies, specifically in Greenland.

## 2.1 Changing Arctic

The Arctic as an environment plays an important role in terms of traditional food systems, health, and well-being of the Indigenous people living around it and consequently, the changes impacting the environment must be acknowledged and understood. Environmentally, the Arctic is a sensitive area; as described by Emmerson and Lahn (2012), “relatively simple ecosystem structures and short growing seasons limit the resilience of the natural environment and make environmental recovery harder to achieve” (p. 38). Therefore, damage to the Arctic environment is likely to have long lasting impacts and re-establishment is challenging (Emmerson & Lahn, 2012). Simultaneously, the Arctic is undergoing various changes, including environmental changes resulting from warming of the climate (AMAP, 2017b, 2019) as well as sociocultural changes shaping the epidemiological profile of local communities (Kuhnlein et al., 2013; AMAP, 2018b).

The environmental changes, influencing the lives and traditional food systems of the Indigenous people around the Arctic, are often connected to climate change. Certainty concerning globally rising temperatures associated with climate change exists and alarmingly, the warming is occurring twice as fast in the Arctic regions compared to the global average (AMAP, 2017b). In fact, temperatures have risen 0.6 °C decennially over the last 30 years in high latitudes (Schuur et al., 2015, p. 171). Rising air, surface, and ocean temperatures related to climate change are in turn associated with decline in sea ice, decrease in the area duration of snow cover, loss of land-based ice, ocean acidification, more frequent extreme weather conditions, and thawing of permafrost. All of which will have impacts at local and global levels; stress and disruptions of Arctic ecosystems as well as human settlements and infrastructure, loss of biodiversity, coastal erosion, alterations in the Arctic water cycle, changes in the carbon storage and emissions, and contributions to sea-level rise will all have further consequences characterised with great uncertainty. (AMAP, 2017b, 2019.) These environmental changes have also major impact on the lives of the Indigenous and local people in the face of unprecedented challenges that threaten the traditional lifestyles, food and water security, and overall sustainability, especially, of small, rural communities around the Arctic (Berner et al., 2015, p. 127). The pressing challenges highlight the importance of adaptation and

resilience of those communities and the individuals residing there. They also call for a more holistic approach to acknowledge and appreciate the interdependent relationship between people and the environment.

## **2.2 Arctic One Health and the Indigenous worldview**

One Health serves as an approach acknowledging the interconnectedness of people, animals, plants, and the environment, and the need for multi- and cross-disciplinary collaboration in order to address the challenges of the world today. Although definitions of One Health may vary and are continuously evolving (Gibbs, 2014), in the essence of the concept remains a holistic approach to health, a humble recognition of disciplinary limitations calling for collaboration, and the understanding of humans as an inseparable part of the ecosystem influencing the welfare of one another. The One Health Commission (2020) defines One Health as:

a collaborative, multisectoral, and trans-disciplinary approach – working at local, regional, national, and global levels to achieve optimal health and well-being outcomes recognizing the interconnections between people, animals, plants, and their shared environment (para. 1).

Importantly, One Health approach also acknowledges the complexity of health and has adapted the definition by WHO (1948) describing health as “a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity” (Gibbs, 2014). Thus, the determinants of health expand beyond biomedical focus, including personal, cultural, social, spiritual, economic, and environmental factors. Therefore, the importance of personal experiences is acknowledged and valued along with objective measures of and indicators for health and well-being.

One Health approach has been discussed (Hueffer et al., 2019; Ruscio et al., 2015) and implemented (Abass et al., 2019; SDWG, 2020) also in the Arctic context. Sustainable Development Working Group (SDWG) of the Arctic Council has adapted the concept of One Health to strengthen the circumpolar resilience; the project “One Arctic, One Health” is operational for the sixth year aiming to build multidisciplinary collaboration and

enhance communication with the local communities to increase understanding of climate change vulnerabilities and impacts on the health and well-being of people, animals, and the environment (SDWG, 2020). Applying One Health in the Arctic context is not only useful but also seems natural; the interdependent relationship between human, animal, and environmental health corresponds with the holistic worldview of many northern Indigenous cultures (Hueffer et al., 2019, p. 2).

The Indigenous perspectives on health and well-being have recognised the holistic nature of individual health, “self” combined with the importance of “the community” and “the land”, including the environment and wildlife (Yadeun-Antuñano, 2019). Indeed, the Indigenous worldview and understanding of health and well-being has applied ancient knowledge, understanding, and insight of the physical, mental, and spiritual aspects of well-being and the interconnectedness of people, animals, plants, and the environment that have only relatively recently been recognised also in Western science and discussed in terms of, for example, One Health. In accordance with the One Health approach’s holistic take on health, in respect to the Indigenous worldview, this thesis defines health holistically encompassing physical, mental, and spiritual aspects.

### **2.3 Health and mental wellness of Indigenous peoples in Arctic research**

As health and well-being can be approached and defined in countless of different ways, the indicators and measures used in research vary extensively. Some indicators used in Arctic research in relation to human health, well-being, and development include a variety of different mortality statistics, disease rates, behavioural indicators, population statistics, and housing conditions among many others (Hamilton et al., 2010). Besides these more objective measures and indicators of health, health and mental wellness can be measured aiming to capture the perception of health and well-being at individual level, rather than defining the presence or absence of an illness or related symptoms. This thesis focuses on the more subjective measures of health and well-being and therefore, a short description of previously used measures and indicators in the Arctic context, is provided. This will, also, serve as background and provide definitions for the indicators utilised later in this thesis.

Human health, well-being, and development have been defined and measured within domains identified in and indicators developed for several reports, projects, and surveys in Arctic research, including the Arctic Human Development Report (Larsen & Fondahl, 2014), Arctic Social Indicators (Larsen & Edwards, 2014), and Survey of Living Conditions in the Arctic (SLiCA) (Poppel, 2015). Moreover, some of the core indicators in terms of individual health and well-being have been defined and utilised in SLiCA in context of the Inuit, including SRH, satisfaction with life, (satisfaction with) quality of life, and well-being (Poppel, 2015). Likewise, in this thesis the emphasis and focus on health and well-being rely on the individual perception of one's own health, well-being, satisfaction with their life, and experienced quality of life as the core indicators of subjective health and mental wellness separate from the biomedical state of health.

SRH is frequently used and well-established indicator for a perception of health reflecting both physical and mental aspects of it. In fact, SRH has been found useful in predicting mortality, morbidity, and use of health services even after controlling for various physical, psychological, social, and demographic factors. (Eriksson et al., 2001.) Although, the variety of factors influencing individual's perception and evaluation of their health have been also discussed and should be born in mind when applying SRH. These factors include: factors related to the health status of the individual such as diagnosis, symptoms, health behaviour and knowledge, use of medication, as well as to the health environment moulded by cultural norms, level of education, media and more; psychological factors, including response process, cognitive abilities, motivation, mental health, personality traits; social factors such as socioeconomic status, age, gender, ethnicity, acculturation, religion, environmental exposures, and; factors related to the survey measurement and the study methodology itself (Garbarski, 2016). SRH has been used in Arctic research as a proxy for combined physical and mental health in several studies, for example, as an outcome of itself (Spein et al., 2013), in relation to sociocultural factors (see for example, Hansen et al., 2010; Eliassen et al., 2012), and as a SLiCA indicator reflecting also the broader domains identified in Arctic Human Development Report and Arctic Social Indicators report especially in relation to Inuit (Poppel, 2013).

Other aspects of individual experience on health and well-being relates to the notion of mental health or mental wellness. WHO (2018) defines mental health as “a state of well-being in which an individual realises his or her own abilities, can cope with the normal stresses of life, can work productively, and is able to make a contribution to his or her community” (para 2), acknowledging subjective well-being as an important factor for mental health. The importance of well-being has been also recognised in Arctic research and several indicators have been developed and utilised to measure individual well-being. As defined in SLiCA (Poppel, 2013), individual well-being covers all aspects of living according to individual perception, including a subjective evaluation of one’s objective resources and other living conditions (p. 257). Importantly, the concept of well-being and related measures utilised in SLiCA acknowledge the discrepancy between Indigenous and another perception of well-being defined and utilised by Western social sciences incorporating social indicator systems used in the context of industrial societies. Further, they aim to reflect the worldview, way of life, and priorities of the Indigenous peoples in question. (Poppel, 2013, p. 257.)

Besides direct indicator for individual or subjective well-being, other measures have been used to encompass different aspects of such a complex concept, for example, satisfaction with life and quality of life (Organisation for Economic Co-operation and Development [OECD], 2013; Poppel, 2013, 2015; Rautio et al., 2014). Satisfaction with life, overall and separately, concerning different aspects of life were part of the core questionnaire in SLiCA. Interestingly, in Arctic context, satisfaction with life as a whole, was found to correspond mostly with satisfaction with “standard of living”, “personal health”, “opportunities to hunt and fish”, and “combination of productive activities”. (Poppel, 2015, pp. 63-64.) Overall satisfaction with life (or satisfaction with life as a whole) has been broadly discussed and, according to the OECD (2013), it is relatively intuitive referring to the overall experience of life rather than momentary feelings of satisfaction. Closely related, quality of life has been used also in relation to subjective well-being, at times also interchangeably with it. However, according to Diener et al. (1999) quality of life encompasses the differences in how people react to life events and circumstances, and how they evaluate their living conditions, which in turn, is influenced by a range of different factors, including expectations, values, and personality. Quality of life has also

been used as an indicator for health and well-being in the Arctic context in SLiCA (Poppel et al., 2015).

Overall, defining and measuring individual experience of health and well-being can include a variety of tools and indicators, many of which seem to be closely connected. Furthermore, many different indicators have been applied broadly in research conducted in the Arctic and in relation to Indigenous peoples. Oftentimes, it seems useful to combine several different indicators to capture a holistic picture of individual and population health and well-being. As mentioned before, in this thesis, the term “mental wellness” includes the aspects of subjective well-being, satisfaction with life, quality of life, and feelings of empowerment, of which the latter is discussed in more detail in chapter 2.7.2.

## **2.4 Traditional food systems of Indigenous peoples**

Traditional food of Indigenous peoples’ is essential aspect of Indigenous cultures and contributes to the health and mental wellness of Indigenous communities and individuals. Traditionally, food and nutrition have been approached from a single point of view, either in relation to the field of expertise or in terms of a specific activity or actor in the food production chain. In turn, as described by Food and Agriculture Organisation (FAO) (2018) food systems approach provides an alternative that aims to capture all the elements, activities, processes, and actors involved in the life course of a food item, including the production, distribution, consumption, and disposal. It encompasses the holistic totality of food systems, including all the relevant components and their interlinkages, as well as the societal, economic, and environmental impacts (FAO, 2018). Indeed, food systems approach is strongly intertwined with the notion of sustainability (Alsaffar, 2016), sustainable food systems are included in the Sustainable Development Goals (UN, 2020), and used as a better and more comprehensive way of approaching the complex problem of global food insecurity (FAO et al., 2020; FAO, 2018).

Traditional food systems refer to the food systems of Indigenous peoples within the local context, including: all culturally acceptable foods available from natural resources; the sociocultural meanings; the methods of acquisition, preservation, and preparation; usage and related nutritional consequences (Kuhnlein & Receveur, 1996, p. 418). Food is often

acquired through subsistence activities, including hunting, fishing, and gathering creating a solid foundation for an active lifestyle and a connection with the environment. Together, the cultural importance and connection with nature are, in fact, essential elements highlighted in the traditional food systems approach. Indeed, food is in the heart of the Indigenous cultures stemming from the knowledge that has been passed through generations building up to a holistic understanding of the local environment. (Kuhnlein et al. 2009, 2013.) Moreover, traditional food systems contribute to the health and well-being of Indigenous communities and individuals beyond physical benefits, including aspects of mental and cultural well-being, spirituality, healing, and protection from disease (Kuhnlein et al., 2013, p. 3). Kuhnlein et al. (2013) and Kuhnlein et al. (2009) illustrate the importance of traditional food systems for Indigenous peoples by providing examples from Indigenous communities around the world, including the Arctic (Egeland et al., 2009).

In this thesis, the term traditional food, or country food, are used according to the description by Kuhnlein (2009) as, foods accessible to Indigenous people locally from natural environment through subsistence activities while utilising traditional knowledge (p. 3). Subsistence activities refer to hunting, fishing, and gathering as means to obtain food, as well as clothing, shelter, and livelihood (Hueffer et al., 2019, p. 4), and gathering refers to all foods such as fruits, berries, mushrooms, plants, roots, and eggs collected from the local environment.

## **2.5 Greenland and traditional food systems**

Traditional food systems remain a topic of interest around the Arctic, also in Greenland. Greenland is the world's largest island of which approximately 80% is covered by icecap and glaciers, and the soil made of continuous or discontinuous permafrost (Christiansen et al., 2010), providing a challenging living environment of mostly high Arctic climate with cool summers and harsh winters (Statistics Greenland, 2020). Greenland was inhabited by Indigenous people migrating from Canada in several migration waves 4000-5000 years ago (Moltke et al., 2015). Since 1721 it served as a Danish colony, was granted Home Rule in 1979, and established self-government in 2009. The population of Greenland is approximately 56,000 of which nearly 90% are born in Greenland. (Statistics



Greenland, 2020.) Noteworthy, the definition of indigeneity varies around the world and similarly to Nordic countries, Greenland does not hold record based on ethnicity. Therefore, those born in Greenland are considered Indigenous Greenlanders regardless of the level of Inuit ancestry. (Jungsberg et al., 2019, p. 17.) Additionally, majority of migrants in Greenland come from Denmark (Statistics Greenland, 2020). Overall, the population of Greenland is sparsely populated and besides the largest town, the capital Nuuk with population of nearly 15,000 people and couple other larger towns, most of the population of Greenland live, in fact, in villages or settlements with less than 5,000 inhabitants (Jungsberg et al., 2019, p. 13-16). The infrastructure remains poor due to long distances, rocky terrain, and harsh climate; there are no roads or railroads between towns and therefore, travelling locally as well as to and from Greenland, is possible only by air or sea (Statistics Greenland, 2020).

Traditional food of Greenland is well-researched and has provoked interest for decades due to its uniquely high proportion of fat and protein (see for example, Bjerregaard & Jeppesen, 2010; Deutch et al. 2007; Sowa, 2015; Watson, Miles et al., 2018). Traditional Greenlandic diet relies heavily on meat, fat, and organs of marine mammals, fish, and some terrestrial animals, including reindeer and polar bears, and different bird species obtained from the local natural environments through subsistence activities (AMAP, 2017a; Bjerregaard & Jeppesen, 2010; Sowa, 2015). Today, traditional food accounts for approximately 20-30% of the total energy intake in Greenland (Baines et al., 2015; Bjerregaard & Jeppesen, 2010; Jeppesen & Bjerregaard, 2012). Seal is commonly consumed, whereas whale consumption is determined more by the region and season (Baines et al., 2015). Similarly, Jeppesen and Bjerregaard (2012) found that the highest portion of traditional food consisted of marine mammals highlighting their continuously important role as part of traditional diets in Greenland. The seal liver and whale blubber, *mattak*, consumed raw, are considered local specialties (Sowa 2015, p. 290). The traditional preservation and preparation methods favour naturalness, and the foods are often served raw, dried, boiled, frozen, or smoked (Bjerregaard et al., 2001; Sowa, 2015, p. 290). The contemporary role of traditional food systems in terms of consumption of traditional food and subsistence activity patterns and related ongoing sociocultural and environmental changes, will be discussed from the chapter 2.5.

The traditional food of Greenland is paradoxically associated with health risks especially in relation to high levels of contamination found in the environment and high levels of human exposure (Kuhnlein et al., 2013; AMAP, 2015; Weihe, Debes, et al., 2016; AMAP, 2018a) and various economic, cultural, social, and health benefits (Kuhnlein et al., 2009; Kuhnlein et al., 2013; AMAP, 2017a). The conflicting effects associated with traditional food of the Inuit is also referred to as the “Arctic dilemma” (AMAP, 2015, p. 111). Moreover, the dietary composition and nutrient intake of the traditional foods has yielded controversies and opposing opinions in relation to health. These different approaches to the interlinkages between traditional food systems and health and well-being are discussed and analysed below in more detail.

## **2.6 Health effects associated with the traditional food systems in Greenland**

As discussed before, the complexity of health has been long understood and health determined through variety of factors beyond biomedical approach. This chapter delves into the literature and previous research on the association between traditional food systems, health, and well-being among people living in Greenland. Moreover, the effects on health and well-being, from both objective and subjective viewpoints, are discussed to provide a comprehensive picture of the interlinkages between traditional food systems and health and mental wellness, and how those associations have been studied and approached in the previous research. However, similarly to the research focus of this thesis, the emphasis is placed on the associations between traditional food systems and subjective measures of health and well-being. Overall, the associations between traditional food systems and objective measures of health and well-being in Greenland have been studied to from various viewpoints representing numerous disciplines. Majority of the research focuses on the objective measures of health and much less is known about the effects on subjective experiences of health and well-being.

### **2.6.1 Environmental contamination**

Environmental pollution is persisting and pervasive problem that has significant impact on the ecosystems and human health (United Nations Environment Programme [UNEP], 2017). This was well-reflected in the literature search as environmental

contamination and related effects on human health were the most discussed topics in the research papers published during the last decade concerning the relationship between traditional food systems of Greenland and health. AMAP has followed and reported on the trends of contaminants in the Arctic as well as their effects on the wildlife and local people since its establishment in 1991 (AMAP, 2017a). Their reports (see for example, AMAP 2015, 2018a) have discussed bioaccumulation and biomagnification of environmental contaminants, especially POPs and mercury, that threaten the Arctic ecosystems and the health and well-being of local communities. POPs are a group of pervasive and persistent chemical compounds, including, for example, organochlorine pesticides (OCPs), dichlorodiphenyldichloroethylene (DDE), per- and polyfluoroalkyl substances (PFAS), and polychlorinated biphenyls (PCBs), that can travel long distances (UNEP, 2017). Global initiatives to restrict the production and the use of POPs and mercury have been implemented and in fact proven effective, to some extent, as reported levels of POPs and metals are decreasing around the Arctic (Abass et al., 2018; AMAP, 2015, 2017a, 2018a). However, the levels of some POPs and metals remain high, especially in Greenland and eastern Canada (AMAP 2015, p. 136), and moreover, new chemicals are causing emerging concern in the Arctic as they remain largely unmonitored and unregulated with poorly understood effects on human health and the environment (Abass et al., 2018; AMAP, 2017a).

Human exposure occurs mostly through consumption of contaminated foods, especially marine mammals (AMAP, 2018b). Several studies support the notion of traditional foods, mainly marine foods, as the main source of the high levels of contaminants, including POPs and heavy metals, measured among Greenlandic populations (see for example, Bank-Nielsen et al., 2019; Hjermitsev et al., 2020, p. 10; Schæbel et al., 2017). The contaminants bioaccumulate and biomagnify through the marine food web resulting in high concentrations especially in predators on top of the food chain which are further consumed by Indigenous peoples as part of their traditional diets (AMAP 2018a, 2018b). Different contaminants found in Greenland affect human health through various mechanisms and result in many different adverse health outcomes, including neurobehavioral, immunological, reproductive, cardiovascular, endocrine, and carcinogenic effects (Weihe, Debes, et al., 2016; AMAP

2015). Many recent and ongoing studies, including INUENDO (Inuit-Endocrine birth cohort), CLEAR (climate changes, environmental contaminants, and reproductive health -birth cohort), IVAAQ (The Greenland Child Cohort), and ACCEPT (Adapting to Climate Change, Environmental Pollution, and Dietary Transition -birth cohort), examine the connections between contamination and health in Greenland, as listed by Weihe, Bjerregaard et al. (2016) in their overview. Research conducted in Greenland between 2010-2020 on contamination associated with the traditional food systems and related health effects are shortly discussed and the main findings are summarised in Table 1 below.

### **Immunological effects**

Developmental exposures to certain pollutants have been suspected to adversely affect development of the immune system (Weihe et al., 2015, p.81). Research in Greenland concerning the immunological effects of exposure to POPs have supported the pro-inflammatory role (Schæbel et al., 2017) and the immunosuppressive potential of POPs (Knudsen et al., 2018). Schæbel et al. (2017) identified a positive association between POPs and markers of inflammation which in turn has an important function in terms of different chronic diseases, including rheumatoid arthritis and atherosclerosis. In turn, Knudsen et al. (2018) found exposure to POPs to influence several haematological markers, especially concerning blood cell counts, in Greenlandic pregnant women suggesting immunosuppressive potential of POPs. Additionally, a recent, small scale cross-sectional study by Haugaard Rasmussen et al. (2019) suggested that the duration of breastfeeding, considered a proxy for postnatal exposure to POPs, might modify asthma and allergy risk in infants of smoking mothers; children with eczema had increased risk of allergy when breastfed more than 12 months possibly due to higher exposure to POPs. Noteworthy, the study has several limitations and weak power due to its cross-sectional design and only 49 participants and therefore, no conclusions can be drawn but rather, further studies are needed to elucidate the findings. (Haugaard Rasmussen et al., 2019.)

<b>Table 1.</b> Summary of findings on the association between contamination and health from studies conducted in Greenland 2010-2020			
<b>Health endpoint</b>	<b>Compound(s)</b>	<b>Findings</b>	<b>Source</b>
Immunological system	POPs	PCBs and OCPs were positively associated with markers of inflammation suggesting pro-inflammatory effects.	Schæbel et al. 2017
		PCBs, OCPs, and PFASs had an influence on several haematological markers suggesting immunosuppressive potential.	Knudsen et al. 2018
		Postnatal exposure might modify asthma and allergy risk in infants of smoking mothers.	Haugaard Rasmussen et al. 2019
Cardiovascular system	POPs	No association was found between PCBs, OCPs, and hypertension.	Valera et al. 2013
	Heavy metals	No association was found between whole blood mercury and hypertension.	Nielsen et al. 2012
		No association was found between whole blood mercury and a risk of developing cardiovascular disease.	Larsen et al. 2018
Reproductive system and foetal growth	POPs	OCPs, PCBs, and PFAS had a negative effect on foetal growth.	Hjermitslev et al. 2020
	Heavy metals	Certain heavy metals, including cadmium, copper, and lead, had an adverse influence on foetal development and growth.	Bank-Nielsen et al. 2019
	Combined effects	Some organochlorines and phthalates adversely affect male reproductive health.	Lenters et al. 2015
Neurobehavioral development	POPs	No association between DDE, PCBs, and developmental milestones in infancy nor motor skills in children.	Høyer et al., 2015
		Positive association between DDE, PCB, abnormal scores for conduct, and hyperactivity in children.	Rosenquist et al. 2017
		PFAS had weak effects on child behavioural development and hyperactivity.	Høyer et al. 2018
Endocrine system	POPs	PCBs and OCPs had no association with body mass index.	Høyer et al., 2014
	Heavy metals	Mercury was weakly associated with impaired fasting glycemia and type 2 diabetes. Mercury had no association with insulin resistance, sensitivity, or beta cell function.	Jeppesen et al. 2015
Carcinogenic effects	POPs	Perfluorinated compounds had positive association with risk of breast cancer.	Bonefeld-Jørgensen et al., 2011
		Exposure to PCBs and perfluoroalkyl acids may increase the risk for breast cancer.	Wielsøe et al., 2017
	Combined effects	Positive association between breast cancer risk and a mixture of POPs.	Wielsøe et al., 2018

Dichlorodiphenyldichloroethylene (DDE), organochlorine pesticides (OCPs), polychlorinated biphenyls (PCBs), per- and polyfluoroalkyl substances (PFAS), persistent organic pollutants (POPs)

### **Cardiovascular effects**

Overall, mercury is considered as a highly toxic heavy metal associated with several adverse effects on human health (WHO, 2017). Some of the highest levels of whole blood mercury have been found in Greenland (Larsen et al., 2018). Interestingly, no association was found in Greenland between whole blood mercury and hypertension in a cross-sectional study by Nielsen et al. (2012), although uncertainties remain due to the study design and methodology, including possible confounders not accounted for in the analysis. Similarly, Larsen et al. (2018) did not find an association with whole blood mercury and a risk of developing cardiovascular disease (CVD) in their prospective longitudinal cohort study. In turn, research conducted in Greenland on POPs and cardiovascular health has also provided contradictory results compared to the known risk factors associated with POPs. For example, a cross-sectional study by Valera et al. (2013) did not provide evidence to support an association between PCBs, OCPs, and hypertension.

### **Reproductive effects and foetal growth**

In terms of male reproductive health, Lenters et al. (2015) identified adverse associations between several contaminants and different biomarkers of male reproductive function, including decreases in serum testosterone levels and sperm motility. The study utilised multipollutant modelling to assess possible associations between exposure to several plastic-associated chemicals (phthalates), POPs, heavy metals, and male reproductive health. In turn, different contaminants have been acknowledged also as a concern for foetal health, likewise in Greenland. Hjermitsev et al. (2020) found certain POPs to have negative effect on foetal growth. Similarly, prenatal exposure to different heavy metals can have a negative impact on foetal development and growth in dose-response relationship; a cross-sectional ACCEPT study by Bank-Nielsen et al. (2019) identified especially cadmium and copper to have an adverse association with birth outcomes, including reductions in birth weight, height, and head circumference, and the latter with preterm birth.

### **Neurobehavioral effects**

Prenatal exposure to contaminants, especially mercury, have been a concern in terms of developing brain that is considered the most vulnerable organ system (Weihe, 2015, p.

97). In Greenland, most research has focused on the connection between pre- and postnatal exposure to POPs and related neurobehavioral impacts. POPs were not associated with developmental milestones during infancy nor with motor skills of children from 5 to 9 years of age (Høyer et al., 2015). Noteworthy, the outcome measures were assessed using retrospective parental reports and therefore, as noted by the authors, to detect possible subtle effects, more sensitive outcome measures should be used. (Høyer et al., 2015, pp. 9-10.) In turn, studies by Rosenquist et al. (2017) and Høyer et al. (2018) deriving from the same INUENDO cohort, identified associations between prenatal and early childhood exposure to POPs and child behaviour indicating positive association between DDE and PCB on abnormal scores of conduct and hyperactivity (Rosenquist et al., 2017), and weaker yet, significant, positive association between PFAS and child behavioural development and hyperactivity (Høyer et al., 2018).

### **Endocrine effects**

Different environmental chemicals have been identified as endocrine-disrupting interfering with the endocrine system of the body and further resulting in a range of different adverse health effects (Weihe et al., 2015, p. 83). With high and increasing prevalence of type 2 diabetes and impaired fasting glucose in Greenland, Jeppesen et al. (2015) evaluated the association between whole blood mercury and glucose intolerance in their cross-sectional study. They found a weak, yet significant association between whole blood mercury and both, impaired fasting glycemia and type 2 diabetes, and no association regarding insulin resistance, sensitivity, or beta cell function after adjustment for several potential confounders. Interestingly, the authors noted the importance of other factors, genetic and lifestyle related, including intake of sugar and saturated fat, smoking, and physical inactivity in comparison with mercury exposure suggesting the prior to contribute more to the risk of glucose intolerance development in Greenland (pp. 195-196). No association was found between prenatal and early-life exposures to OCPs, PCBs, and body mass index at five to nine years of age in a prospective birth cohort with participants in Greenland, Poland, and Ukraine (Høyer et al., 2014).

### **Carcinogenic effects**

The cancer incidence, especially for the cancers associated with lifestyle, has increased during past decades significantly among all circumpolar Inuit and research has aimed to

determine the carcinogenic effects of different contaminants (Weihe et al., 2015, p. 98). Previously extensive, yet inconclusive research regarding a possible association between exposure to POPs and breast cancer have also been assessed in Greenland (Bonefeld-Jørgensen et al., 2011; Wielsøe et al., 2017, 2018). The studies have identified significant positive associations between breast cancer risk and exposures to single POPs (Bonefeld-Jørgensen et al., 2011; Wielsøe et al., 2017) as well as to a mixture of POPs in serum (Wielsøe et al., 2018) in Greenlandic women.

Noteworthy, overall, most of the research concerning contamination in Greenland and related health impacts, focuses on single exposures. However, often people are exposed to multiple contaminants simultaneously with unknown interactions and combined effects. Studies on the effects related to multiple exposures remain limited in Greenland, and elsewhere (Larsen et al., 2018, p. 314). Overall, environmental contamination has been studied extensively concerning the traditional food systems of Greenlanders, during the past decade, far more than any other aspect. Importantly, the possible adverse health effects of environmental contamination must be weighed against the various health benefits associated with the consumption of traditional food and subsistence activities (AMAP 2018b, p. 77).

#### 2.6.2 Dietary composition and nutrients

The dietary composition of traditional and modern food in Greenland has been broadly studied and discussed. In fact, the literature searches yielded second most results focusing on the dietary composition and nutritional intake of Greenlanders and related health effects, compared to the highest emphasis on the effects of contaminants. The local traditional diet relies heavily on fat and protein and the access to fresh fruits and vegetables remains very limited representing a contrast to the current international dietary guidelines (WHO, 2020), and therefore, it has remained under scientific curiosity for decades. However, traditional foods have been increasingly replaced with imported foods which will be discussed in more detail later.

Since the ground-breaking report by (Bang et al., 1976) on the low incidence of atherosclerosis among the Greenlandic Inuit credited to their unique diet high in



polyunsaturated fatty acids (PUFAs) derived from marine foods, suggesting the Inuit to be healthier than people in the Western world, the report, its methods, results, and conclusions, have been challenged and the relationship between PUFAs, as well as other fats, and health continuously researched. For example, DiNicolantonio (2016) discusses the role of refined carbohydrate and sugar introduced to Greenlandic diet early 1900s since when the total carbohydrate intake rose significantly parallel to the rise of atherosclerosis diseases, and the flagship study by Bang et al. (1976) situated in time where the traditional diet had already been replaced largely by imported foods high in refined carbohydrates and sugar. DiNicolantonio (2016) argues that in fact the overconsumption of sugar, associated with type 2 diabetes, hypertension, and CVD, could be more likely the cause of the decline in the health of the Greenlandic population.

Overall, recent studies have provided new insights into the debate highlighting the complexities surrounding the topic. Schæbel et al. (2013) found that biomarkers of inflammation, associated with atherosclerosis and CVD, increased with higher intakes of traditional diet in Greenland. However, the causality remains unestablished, and they have been speculated to reflect the disease itself rather than a cause of it. (Schæbel et al., 2013.) In turn, the composition of nutrients and n-3 fatty acids in the traditional Inuit diet appears to provide some protection against CVD and type 2 diabetes in a study by Deutch et al. (2007). However, research concerning the association between traditional diet and type 2 diabetes and glucose intolerance has been contradictory. On one hand, the rise in the type 2 diabetes and other lifestyle diseases has been associated with the sociocultural transition and urbanisation; earlier studies conducted in Greenland have indicated a low prevalence of type 2 diabetes compared to Western populations (Jeppesen et al., 2014; Møller et al., 2021). Yet, paradoxically, traditional diet has been associated positively with type 2 diabetes and impaired fasting glucose (Jeppesen et al., 2014). The contradictory findings highlight the uncertainties and complexities regarding the mechanisms behind glucose intolerance and type 2 diabetes. Also, the role of, for example, contaminants and genetic factors need to be better evaluated. Interestingly, there is an ongoing randomised clinical trial aiming to determine whether traditional diet will improve glycaemic control in Greenland compared to a Western diet accounting for also certain genetic factors (Møller et al., 2021).

Notably, traditional Greenlandic foods are import sources of protein, and most minerals (including iron, zinc, iodine, selenium), antioxidants, vitamin D, and PUFAs (Baines et al., 2015; Bjerregaard & Mulvad, 2012). Bjerregaard and Jeppesen (2012) analysed the adherence to nutritional guidelines in Greenland by using Food Frequency Questionnaires and concluded that consuming traditional food has a beneficial effect on the fatty acid profile of the diet and the intake of refined sugar but resulted in lower fibre intake (Bjerregaard & Jeppesen, 2012). Also, Munch-Andersen et al. (2012) found metabolic profile more favourable among Inuit following traditional diet compared to those with more westernised diet. Additionally, traditional Greenlandic diet has been associated with higher levels of vitamin D (Schæbel et al., 2015) which in turn, plays an important role in skeletal health (Andersen et al., 2013). Also, both selenium and n-3 fatty acids have been suggested to counterbalance some of the adverse effects of mercury (Genchi et al., 2017) which is an interesting as some of the major concerns, as well as the controversial findings in terms of traditional diet and health outcomes, are contributed to the contamination.

Overall, research has shown a decrease in the intakes of vitamins C, D, A, and E, as well as of folate and calcium over the past decades, alongside with the decrease in the consumption of traditional foods (Andersen et al., 2013; Bjerregaard & Jeppesen, 2012; Nielsen et al., 2014). In turn, vitamin D deficiency increases the risk of osteoporosis and has been associated with other adverse health outcomes, such as type 2 diabetes, CVD and several types of cancer (Andersen et al., 2013; Sharma et al., 2011) as well as speculated to have anti-inflammatory potential (Schæbel et al., 2015). However, in Greenland, low levels of vitamin D were not found to be associated with type 2 diabetes (Nielsen et al., 2016) and the anti-inflammatory effect of vitamin D was not supported (Schæbel et al., 2015). Additionally, in their longitudinal study, Paunescu et al. (2013) found a positive effect of frequent consumption of fish and marine mammals to bone intrinsic quality and strength in Inuit women in Greenland. Additionally, Baines et al. (2015) found that higher intake of vegetables, whale, and seal were all independently associated with better lung function, and Wielsøe et al. (2016) did not identify an association between self-reported intake of traditional foods and breast cancer but did find higher levels of consumption of fruits and vegetables together to reduce the risk of breast cancer.

### 2.6.3 Microbiological profile

In recent years, there has been an increasing interest in human microbiome, especially gut microbiota, and its role in health and disease. Human microbiome refers to human body as a complex ecosystem, including unique and distinct microbial biotas in different body systems and regions. According to current understanding, our biota has roots in our inherited genetic system and is further shaped by external exposures, for example, dietary inputs. Gut microbiota has been found to play a role in human health in terms of chronic, metabolic, and inflammatory diseases as well as mental health. (Depken, 2019.) Alongside with modernisation the gut microbiota has grown less diverse, and the current research aims to develop better understanding of the reasons behind such wide-spread phenomena (Eisenstein, 2020; Sonnenburg & Sonnenburg, 2019). Interestingly, several studies have identified clear distinction in the gut microbiota between urban populations and Indigenous peoples deriving from traditional food systems, suggesting the latter to have significantly richer gut microbiota (see for example, De Filippo et al., 2010; Obregon-Tito et al., 2015; Schnorr et al., 2014).

The growing interest in the gut microbiota has proliferated multiple studies, recently also ones aiming to describe and define the microbiological composition of different traditional Greenlandic foods (Hauptmann, Paulová, Hansen et al., 2020; Hauptmann, Paulová, Mejía et al., 2020). Hauptmann, Paulová, Hansen et al. (2020) examined various traditional Greenlandic foods mapping out their microbial composition, and Hauptmann, Paulová, Castro-Mejía et al. (2020) analysed and compared the microbial composition of three different species of industrially and traditionally dried fish. Interestingly, traditional drying methods were found efficient in limiting the unfavourable microbial growth and avoiding food spoilage, and the microbiome of industrially dried samples was more uniform in comparison to the fish dried with traditional methods (Hauptmann, Paulová, Castro-Mejía et al., 2020). Additionally, Hauptmann, Paulová, Hansen et al. (2020) discuss the insects and parasites found in traditional foods as a component adding to the microbial diversity and considered as a potential source of nutrients. Interestingly, the samples from the caribou rumen were rich in microbes associated with plant-rich diet and with positive implications to health. Although, caribou rumen is rarely, if at all, consumed

nowadays in Greenland, the importance of it to a population with very poor access to plant-based foods remains unclear. (Hauptmann, Paulová, Hansen et al., 2020.)

These studies approach the traditional Greenlandic foods and related preparation methods from new perspective adding a new element to the discussion over the health implications associated with the traditional food systems. However, the research is still in its infancy and thus, uncertainties around the topic remain and the need for more research is evident. Moreover, some of the traditional foods referred to by Hauptmann, Paulová, Hansen et al. (2020) are disappearing delicacies, no longer part of the diets even among communities with high consumption of and reliance on the traditional foods. Nevertheless, with increasing understanding over the significance of gut microbiota for health and the acquired knowledge of the richness of the microbial composition in traditional foods of Indigenous peoples, such aspect should not be overlooked but rather looked into also in the context of Greenland.

#### 2.6.4 Genetic adaptation to diet

The implications of dietary intake on individual and population health have been recently approached through studies focusing on genetic adaptation, also in the context of the isolated populations residing Greenland. Although the research remains limited, Greenlanders show signs of genetic adaptation to their unique diet rich in protein and fatty acids, as well as to the cold temperatures of their living environment (Anderson & Hansen, 2018). For example, some studies have identified signs of selection for genetic variants in fat metabolism promoting their coping with and even requiring the high amounts of PUFAs associated with their traditional diets (Fumagalli et al., 2015; Senftleber et al., 2020). The selected genes have an association with fatty acid metabolism and growth hormone regulation (Fumagalli et al., 2015; Skotte et al., 2017), as well as providing a protective effect on the levels of cholesterol and triglycerides (Fumagalli et al., 2015). In turn, Bjerregaard (2013) provides evidence on an association between the n-3 fatty acids and high-density lipoprotein among Greenlanders thus, contributing to the understanding of possible differences between different genetic background and health related risk factors in terms of dietary intake. Noteworthy, although certain genetic variants among Greenlanders may have been historically advantageous with high levels

of consumption of traditional foods, may now, in relation to the rapidly changing lifestyles and dietary patterns be rather neutral or even relate to adverse health outcomes (Skotte et al., 2017).

This brief, and by no means exhaustive, peak into some studies concerning genetic adaptation to diet in the context of Greenland provide yet again, another viewpoint when assessing the interlinkages between different foods, dietary patterns, and various health outcomes further contributing to the complexity of the relationship between diet and health. However, the studies on the genetic adaptation to diet in Greenland remain limited and nonunanimous, and the practical implications of the findings are yet to be seen. However, the possible influence of genetic adaptation on the relationship between food and health should be acknowledged.

#### 2.6.5 Sociocultural importance

The sociocultural importance of traditional food systems for Indigenous peoples has been studied and acknowledged yet, much less is known about the interlinkages between these sociocultural aspects of traditional food systems and health. Research concerning the sociocultural importance of traditional food systems of Indigenous Greenlanders is limited although, traditional food and subsistence activities remain in the core of their culture and identity (Bjerregaard & Mulvad, 2012; Schweitzer et al., 2014, p. 135; Sowa, 2015).

In their review, MacDonald et al. (2013) identified learning and practicing traditional culture as protective factors enhancing mental health of the Indigenous youth of Circumpolar region. Traditional food systems were associated with individual factors, including happiness, wellness, and health as well as strengthening the sense of belonging (p. 11). The notion of spirituality in relation to traditional food stems from the connections with the environment and relates strongly with subsistence activities, especially hunting (Larsen & Fondahl, 2014, p. 119). Indeed, subsistence activities connecting with the surrounding environment have been associated with self-reliance, mindfulness, self-confidence, awareness of the consequences of one's actions, and a sense of purpose (MacDonald et al., 2013, p. 7). Similarly, Sowa (2015) identified the importance of

traditional food on collective and cultural level strongly connected to identity, described as the “way of being Inuit” (Sowa, 2015, p. 295). In turn, Eliassen et al. (2012) discusses the effects of acculturation referring, in the context of Indigenous peoples, to the cultural modification related to the processes of colonisation and the ongoing modernisation and subsequent sociocultural change. They used five scale SRH as an indicator for a composite measure of mental and physical health and identified acculturation as a risk factor for poorer SRH in Greenland (Eliassen et al., 2012). Additionally, in Greenland, traditional foods have been simply described more “tasty and nourishing” (Sowa, 2015, p. 295) and perceived healthier and more satisfying compared to imported foods (Watson, Miles et al., 2018).

Also, traditional food systems in Greenland have a strong notion of social importance in terms of family relations, sharing, and receiving food (Sowa, 2015). MacDonald et al. (2013) discuss the social aspect of traditional food systems in Greenland; collecting and sharing country food within friends, family, and the community enhanced social cohesion, strengthened the relationships within families, and developing ethnic pride and identity (pp. 9-10). Furthermore, traditional subsistence activities continue to have economic significance translating to a main source of income for many (Poppel, 2015, p. 56) as the consumption of traditional food remains more common in rural regions (Schæbel et al., 2017) and among people with lower income (Larsen & Fondahl, 2014, p. 105).

#### 2.6.6 Physical activity

As discussed before, subsistence activities, including fishing, hunting, and gathering, continue to have great economic, social, and cultural importance (Sowa, 2015; AMAP, 2017a, p. 83) as well as are associated physical activity. In Greenland, traditional lifestyle has been associated with higher levels of physical activity; the time spent on domestic and occupational physical activity decreased and time spent on sedentary activities increased alongside with the sociocultural transition that is the shift away from the traditional lifestyle (Dahl-Petersen et al., 2011). These changes in physical activity patterns associated with the socioeconomic transition, have been suspected to contribute to the rise in chronic lifestyle diseases witnessed among Indigenous populations in the

Arctic region, also in Greenland (Dahl-Petersen et al., 2011, p. 678; Munch-Andersen et al., 2012).

Munch-Andersen et al. (2012) aimed to evaluate the metabolic profile among two physically active Inuit groups in Greenland, one group consisted of participants from rural region, living traditional lifestyle, including higher consumption of traditional foods and all year subsistence harvesting and the other group included participants with physically demanding jobs but more modern lifestyles and no regular consumption of traditional foods. They described challenges in recording the levels of physical activity among the Inuit following more traditional lifestyles due to technical issues and unpredictability of the subsistence activities; hunters and fishermen might have left to collect food with short notice for days or even weeks at a time. Although Inuit men took most responsibility in the hunting and fishing activities, women were responsible for processing of the prey and hide and often accompanied the hunters by foot, gathering berries simultaneously. Overall, Munch-Andersen et al. (2012) concluded that despite the challenges with recording, the Inuit following traditional lifestyle performed substantial amount of regular physical activities daily. Regarding the metabolic profiles, glucose intolerance and type 2 diabetes were absent in both groups (Munch-Andersen et al., 2012). The study has several limitations in terms of small number of participants and lack of reliable data. However, the study does provide valuable information describing the physical activities related to subsistence activities among Inuit following more traditional lifestyles in Greenland.

Other studies have also evaluated the relationship between physical activity and health in Greenland. Dahl-Petersen et al. (2017) found that increasing physical activity levels matters in terms of fat distribution manifested through lower body mass index, waist circumference, and abdominal fat accumulation among Greenlanders. In turn, Dahl-Petersen et al. (2013) concluded that physical activity energy expenditure has an important role in terms of glucose metabolism and insufficient physical activity may contribute to glucose intolerance increasing the risk of type 2 diabetes. Unfortunately, neither of the latter two studies separated nor specified physical activity contributable to traditional food systems. However, they do provide evidence to guide more specific recommendations for physical activity as the sedentary lifestyle is becoming more

expected alongside with the socioeconomic and cultural changes. Importantly, such changes are evident especially in urban regions further along the socioeconomic transition, whereas in the smaller settlements and towns the reliance on traditional foods and physical activity levels in terms of subsistence activities remain higher (Dahl-Petersen et al., 2011). Although, in recent years, relatively little research has been conducted concerning the health benefits associated with subsistence practices in Greenland in terms of physical activity.

## **2.7 Ongoing changes influencing the traditional food systems in Greenland**

Integrity of traditional food systems of Indigenous peoples is facing unprecedented challenges around the world as social, economic, political, and cultural changes combine with the pressure caused by environmental stressors, including degradation, biodiversity loss, contamination, and climate change (Turner et al., 2013, p. 25). Likewise, Greenland is undergoing various transitions in terms of sociocultural changes associated with the dietary and epidemiological transitions, as well as the changes in the environment, threatening the health and traditional way of living of Indigenous people in Greenland (AMAP, 2019). These different ongoing transitions and their possible implications to the traditional food systems and health of the local people are discussed in more detail below.

### **2.7.1 Sociocultural changes and related challenges**

Globalisation, urbanisation, and modernisation have triggered the ongoing sociocultural changes in Greenland that are evident, for example, through the shift away from traditional lifestyles and dietary transition where the proportion of traditional foods in diet has been decreasing parallel with subsistence activities and being replaced with imported foods and more sedentary lifestyle (Deutch et al., 2007; Hansen et al., 2008; Dahl-Petersen et al., 2011; Sowa, 2015; Watson, Miles et al., 2018). These sociocultural changes and dietary transition are reflected in the epidemiologic transition, that is evident in the changing trends in disease patterns from infectious diseases to non-communicable, diet-related diseases associated with modern lifestyles, including type 2 diabetes, CVD, and cancer (Bjerregaard & Larsen, 2018; Jeppesen et al., 2014).



The proportion of traditional food in locals' diets has been steadily decreasing in Greenland (Bjerregaard & Jeppesen, 2010; Jeppesen & Bjerregaard, 2012; Sowa, 2015; Terkelsen et al., 2018, p. 259). According to Deutch et al. (2007) and Jeppesen and Bjerregaard (2012), the consumption of local foods has decreased to a present average of approximately 20%. A more recent study by Terkelsen et al. (2018) reported an intake of traditional foods of 12% compared to 88% of imported foods among pregnant women in different regions in Greenland. Similarly, the reliance on subsistence activities has declined, fewer people are earning their living as hunters (Sowa 2015, p. 290), and the physically active lifestyle associated with traditional food systems has been increasingly replaced by more sedentary lifestyle (Dahl-Petersen et al., 2011; Terkelsen et al., 2018).

Consequently, traditional diet is replaced with imported foods, including farmed meat, fresh fruits and vegetables, dairy products, and junk foods high in empty calories (Bjerregaard & Jeppesen, 2010, p. 14). Indeed, the imported foods consist of a range of different food items that can be considered either more beneficial or harmful for health and similarly, previous research is inconclusive. For example, Terkelsen et al. (2018) has raised concerns over the high intake of unhealthy imported food items among pregnant women across Greenland, and Bjerregaard and Mulvad (2012) describe the popularity of unhealthy options among imported foods, including soft drinks, sweets, chips, and farmed red meat. In turn, Jeppesen and Bjerregaard (2012) identified higher levels of fibre intake associated with higher levels of consumption of imported foods, although traditional foods were found more beneficial in terms of dietary fat profile. Deutch et al. (2007) have found the intakes of certain vitamins and minerals to have decreased alongside with the consumption of local foods. Importantly, regional and age differences exist in relation to the dietary transition as traditional foods are more commonly consumed in rural region and small settlements, and especially by older people (AMAP, 2017a; Bjerregaard et al., 2001; Milman et al., 2010). In turn, the consumption of imported foods, such as fruits, is found to be highest among the wealthy in the capital and the south of Greenland (Deutch et al., 2007) and foods high in sugar and empty calories (Bjerregaard & Jeppesen, 2010, p. 23) as well as foods of terrestrial origin (Milman et al., 2010) more consumed among young people.

Additionally, contrary to the locally harvested traditional foods, modern, imported foods are not self-supplied and concerns have been raised in terms of food security related to their availability (Nielsen et al., 2013; Watson, Shanks et al., 2018). In their study, measuring the grocery store environment in Northern Greenland, Watson, Shanks et al. (2018) identified several challenges in sustaining availability of healthy imported food items. These included limited storages, harsh weather, insufficient planning, lack of communication and coordination between different stakeholders, inconsistency with the selected food items across time and regions, high costs of food items and transport, fresh foods that are spoiled or wasted at arrival due to shipping protocols and long travel times. Such challenges result potentially in stocking up storages with non-nutritious foods, and seasonally or culturally inappropriate food items. (Watson, Shanks et al., 2018, p. 180-182.) Also Bjerregaard and Mulvad (2012) describe changes in the availability and variation in the imported food items according to the size and location of the community; in smaller, more rural settlements, fresh products tend to be replaced with foods with long shelf life, for example, frozen goods and potatoes. This in turn limits the opportunities for the locals to adhere to the nutritional guidelines and choose the healthier options from the imported foods.

Despite the ongoing changes, traditional food has an important role for many Greenlandic communities, families, and individuals. For example, Poppel (2015) found that most Arctic Indigenous peoples have maintained their traditional subsistence activities. Watson, Miles et al. (2018) studied different factors influencing the health of reproductive age women in northern Greenland. In their study, women described traditional foods as preferable and healthier compared to imported foods (pp. 9-10) although, the importance of imported foods for families was noted also. Furthermore, Sowa (2015) argues that regardless of declines in consumption, the appreciation towards traditional food is in fact, increasing, and symbolises Greenlandic identity (p. 291).

#### 2.7.2 Environmental changes, adaptation, and empowerment

The environmental changes posing challenges to the Arctic, are, naturally, of a major concern also in Greenland in terms of traditional food systems (Ford et al., 2018; Ford & Goldhar, 2012; Hendriksen & Jørgensen, 2015; Tejsner, 2013; Tejsner & Veldhuis,

2018). Examples of ongoing environmental changes affecting traditional food systems as observed in Greenland include warmer temperatures, unstable sea ice, and increased number of accidents due to the instabilities in ice and weather conditions (Hendriksen & Jørgensen, 2015; Tejsner & Veldhus, 2018). Environmental factors are important in terms of overall food availability in Greenland (Ford & Goldhar, 2012; Watson, Shanks et al., 2018). Supplies of both traditional and imported foods are vulnerable to various environmental factors, including weather patterns, ice conditions, hunting quotas, and animals' migrations (Tejsner, 2013; Watson, Shanks et al., 2018), which in turn are affected by the environmental changes. Moreover, the seasonal fishing and hunting activities are based on previous encounters and rationalities formed concerning the local environment (Tejsner, 2013). This local knowledge is threatened by the unpredictabilities related to the ongoing environmental changes. Also, in their case study from West Greenland, Ford and Goldhar (2012) identified vulnerabilities related to the environmental changes to be most profound in terms of hunting and fishing. Furthermore, they discuss how the study participants described the presence of sea ice to have a positive impact and importance in terms of their mental health and sense of well-being (Ford & Goldhar, 2012).

Interestingly, some scholars challenge the popular portrayal of Arctic people as vulnerable and passive victims of environmental changes threatening their ways of living by highlighting the continuous “disequilibriums” (Tejsner & Veldhuis, 2018, p. 704), states of constant change and unpredictabilities in the environment in short and long-time scales while presenting Indigenous and local people in Greenland as resilient and adaptable to those changes (Ford & Goldhar, 2012; Tejsner, 2013; Tejsner & Veldhuis, 2018). For example, Tejsner (2013) discusses how the local fishermen acknowledge the fluctuations concerning the surrounding environment and wildlife and remain open and flexible to them. The use of modern technologies such as GPS and snow scooters combined with the traditional knowledge and strong social networks strengthen the view of Indigenous societies as adaptive and flexible rather than passive recipients of ongoing environmental changes (Ford & Goldhar, 2012; Tejsner & Veldhuis, 2018, p. 713). In relation to the impacts of climate change in the Arctic region, adaptation has been described as “the ability of a community to change, or adopt new behaviours, in order to avoid or minimize risk, and to be able to continue the most important cultural, economic

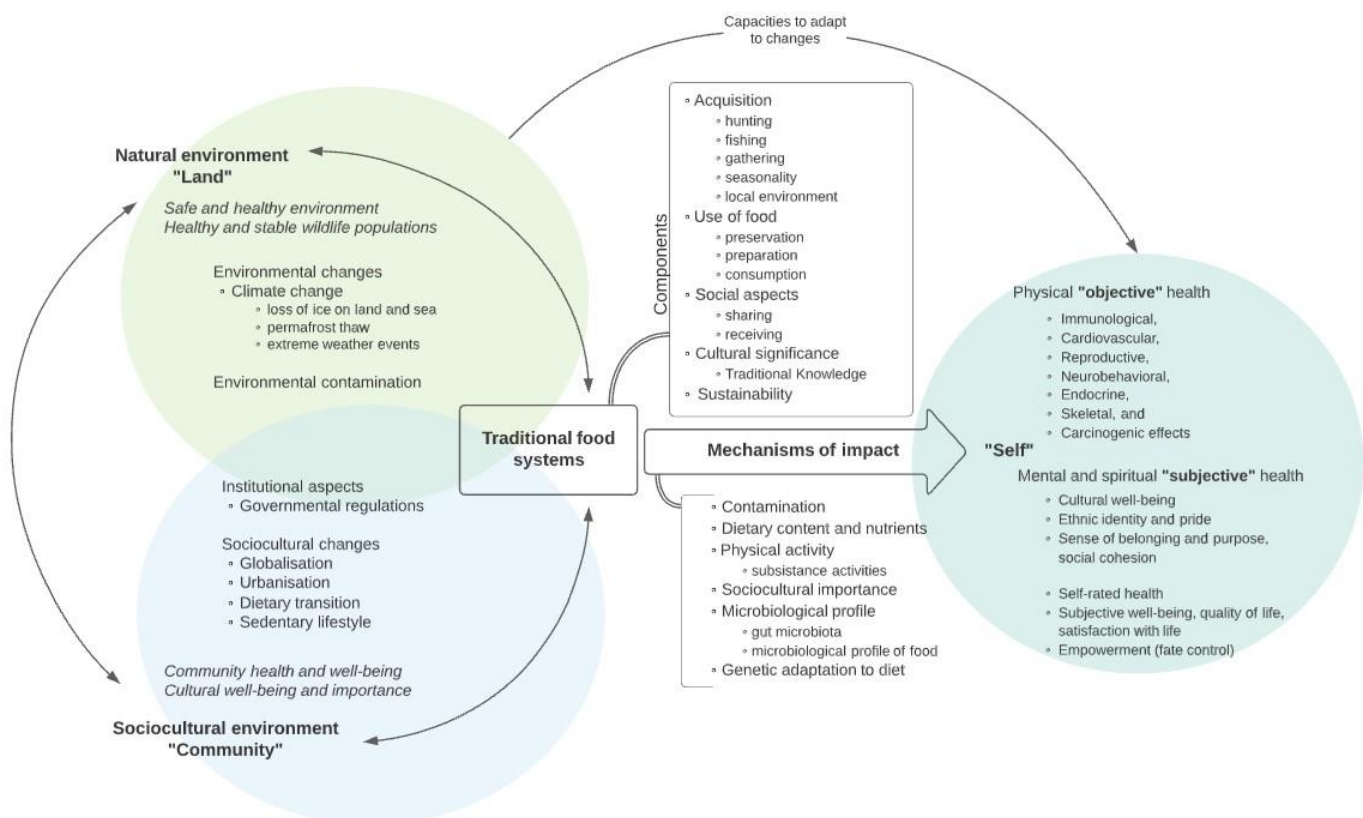
and health-related benefits of the present way of living” (Berner et al., 2015, p. 127). Ford and Goldhar (2012) identified several factors influencing the adaptive capacities on an individual and household levels related to traditional food systems in Greenland: flexibility and diversity in hunting and fishing practices; role of women as wage earners supporting male hunters/fishermen; knowledge of environmental conditions; existence of alternative income sources; and willingness to alter livelihoods. Additionally, governmental regulations concerning, for example, quotas, season dates, and harvest locations, combined with the pressure from the environmental changes, were described as constraining their capacities to adapt (Hendriksen & Jørgensen, 2015; Ford & Goldhar, 2012).

In turn, empowerment has been defined and measured in various ways and applied in many fields, including sociology, community psychology, and health promotion (Ibrahim & Alkire, 2007). However, the use in relation to environmental changes, especially in the Arctic context, remains more limited. In fact, there is no commonly agreed definition or measurement of empowerment, neither generally speaking nor in more specific context of environmental changes in the Arctic. Empowerment is overall a multi-dimensional concept with a range of possibilities for implementation and interpretation. In the Arctic context, empowerment has been discussed and determined through the notion of fate control as part of the Arctic Social Indicators (Dahl et al., 2010). Dahl et al. (2010) describe empowerment as “the process of achieving the capacity to make choices into desired actions and outcomes” (p. 129) and conclude fate control as the outcome of empowerment. Empowerment (or fate control) requires the capacity to make decisions and the resources needed to implement them. (Dahl et al., 2010.) Although, empowerment is not specifically discussed in connection to the ongoing environmental changes they, alongside with the sociocultural changes and related challenges, underline the profound reasons for creating such indicators to track trends in human development in the Arctic in the first place (Larsen et al., 2010, p. 11). Overall, without undermining the Indigenous and local peoples’ capacities to adapt to the changing environment and feelings of empowerment, discussing the vulnerable position of the Arctic people should not be disregarded solely as disrespectful and ignorant, but rather seen as important way to emphasise the urgency of climate related challenges drawing various stakeholders together working towards a shared goal.

## 2.8 Summary: the interlinkages between traditional food systems and health

Figure 2 summarises the literature review and places the previous research on the association between traditional food system and health, conducted in Greenland, into broader theoretical framework relevant for the topic. The main elements in the figure represent the Indigenous perspectives on health and well-being recognising the holistic nature of individual health while acknowledging the interconnectedness of the health of the environment, wildlife, and people in accordance with One Health approach (One Health Commission, 2020). These Indigenous perspectives are adapted from the description of Yadeun-Antuñano (2019): “self” encompassing the complexity of health, including physical, mental, and spiritual aspects; “the community”, or sociocultural environment, highlighting the importance of the community, social relationships, and cultural well-being; and “the land”, or natural environment, encompassing the overall health and well-being of the environment and wildlife. All these elements are interconnected with each other as well as with the traditional food systems of Indigenous people in Greenland.

**Figure 2.** Summary of previous research on the associations between traditional food systems and health conducted in Greenland, in a broader context of theoretical background.



Traditional food systems refer to the food systems of Indigenous peoples encompassing a range of components related to the whole life course of a food item rather than focusing on a single viewpoint (FAO, 2018; Kuhnlein & Receveur, 1996). These components include: the acquisition of food, for example, hunting, fishing, and gathering activities used to harvest food from the local environment with emphasis on seasonality; use of food, including methods of preservation and preparation as well as consumption; and social aspects with a strong notion of sharing and receiving traditional foods between family and community members. Additionally, traditional food systems highlight the cultural significance and importance of traditional knowledge passed through generations. (Kuhnlein et al. 2009, 2013.) Within the context of Greenland, traditional diet relies heavily on meat, fat, and organs of marine mammals, fish, and some terrestrial animals acquired from the local environment through hunting and fishing activities (Bjerregaard & Jeppesen, 2010; Sowa, 2015). In turn, gathering of berries, mushrooms, herbs, and plants is also practiced in Greenland, however, discussed lot less in the literature.

Furthermore, traditional food systems are, indeed, strongly connected to the natural and sociocultural environments; the health and well-being of the environment, wildlife, and people are interconnected (Hueffer et al., 2019). Healthy and safe environment with stable, sustainable wildlife populations contribute to the health and well-being of local communities and individuals enabling them to maintain culturally important practices, and vice versa. Therefore, different aspects, including threats and changes, influencing the natural and sociocultural environments simultaneously impact the traditional food systems and people relying on them. In terms of Greenland, examples of such elements include: environmental changes often linked to climate change influencing especially subsistence activities (Hendriksen & Jørgensen, 2015; Ford et al., 2018; Ford & Goldhar, 2012; Tejsner, 2013; Tejsner & Veldhuis, 2018); environmental contamination influencing the health of the wildlife and humans, mostly through consumption of contaminated foods (Weihe, Debes, et al., 2016; AMAP 2015, 2018b); sociocultural changes manifested through the shift away from traditional lifestyles and dietary transition contributing to epidemiologic transition (Hansen et al., 2008; Dahl-Petersen et al., 2011; Sowa, 2015; Watson, Miles et al., 2018); and institutional factors such as governmental regulations described as additional pressure constraining capacity of local people to adapt to the ongoing changes (Ford & Goldhar, 2012).

The capacities to adapt to the sociocultural and environmental changes have an impact on the health and well-being of the local communities and individuals among many other mechanisms. Overall, the associations between traditional food system and health have been approached from various viewpoints producing information and providing insight on the many different mechanisms how traditional food systems may impact health. Within the context of Greenland, these mechanisms include environmental contamination, dietary content and nutrients, physical activity, sociocultural importance, microbiological profile, and genetic adaptation to diet. Furthermore, the studies measuring these effects on health and well-being have utilised several different indicators either focusing on more physical, rather objective, or mental and spiritual, more subjective, health effects and measures. The objective measures of health have focused on effects impacting the immunological, cardiovascular, reproductive, neurobehavioral, endocrine, and skeletal systems or defined carcinogenic effects related to traditional food systems in Greenland. In turn, the subjective measures have included notions of cultural well-being, ethnic identity and pride, sense of belonging and purpose, connection with the environment, and social cohesion while utilising different indicators, for example, SRH, subjective well-being, quality of life, satisfaction with life, and empowerment, in terms of fate control. Importantly, majority of the previous research focuses on the objective measures of health and much less is known about the effects on subjective experiences of health and well-being. Furthermore, the evidence is conflicting, and traditional food system seems to have simultaneous health risks and benefits.

There are few considerations in terms of previous research conducted in Greenland on the topic. Noteworthy, research concerning traditional diet in Greenland tends to focus on marine and land mammals, and fish, whereas the gathered foods have been lot less studied or discussed in the literature. Similarly, the main emphasis on subsistence activities relies on hunting and fishing and research on gathering remains much more limited. Furthermore, oftentimes, research was conducted on reproductive age women as the health-related concerns are considered especially profound on fertility and foetal development. This was well established especially in studies focusing on the environmental contamination. Additionally, often the adverse health effects associated with the traditional foods have slower onset with limited acute effects, if any. Therefore, a question remains whether Indigenous people, possibly appreciating and valuing their traditional food highly, regard the potential adverse health effects as outweighing the experienced benefits and importance of traditional food.

### 3. RESEARCH AIM AND QUESTIONS

Previous research has primarily focused on the objective indicators of health and well-being in relation to traditional food systems of Greenland. In turn, this thesis focuses on the local peoples' own perspectives in relation to their traditional food systems building on the existing knowledge and providing an additional viewpoint on the topic. The overall aim of this research is to characterise the contemporary role of the traditional food system and related changes and examine the relationship between the traditional food system and self-rated health and mental wellness among the local people within one community in Greenland.

Research questions:

1. *What is the role of the traditional food system and what kind of changes, if any, related to them, have been identified in the community?*
2. *Are there any associations between use and acquisition of traditional foods and related changes, and perceived health, well-being, quality of life, satisfaction with life, and feelings of empowerment?*



## **4. METHODOLOGY**

This thesis is a part of an international research project Nunataryuk that aims to determine the impacts of thawing Arctic permafrost on the environment, climate, and local people, and develop mitigation and adaptation strategies (Nunataryuk, 2020). The study design is cross-sectional and therefore, the analysis remains mainly descriptive with some measures of association, whereas any conclusions of causality between different variables are not possible to draw. Mainly quantitative research methods are used to analyse the data. This chapter provides an overview of the study population and data collection, discusses the chosen study variables in detail, and introduces the methods of statistical analysis used to answer the research questions.

### **4.1 Study population**

The data has been collected in a form of a survey in a community located in Disko Bay, western Greenland, between February and April 2019. The settlement has a small population with less than 1,000 inhabitants of which, approximately 200 were under 18 years of age in 2019, and similarly to many other rural regions and small settlements in Greenland, can be characterised with more traditional ways of living. The community members were encountered and informed about the research project and included in related discussions with a possibility to acquire more knowledge and raise concerns, prior to data collection. The study participants were chosen and recruited utilising snowball sampling and the knowledge of the local project representative familiar with the community members. Only a few members of the community declined to participate. The study population consists of 100 local persons meeting the eligibility criteria of being at least 18 years of age and permanently residing in the settlement. Furthermore, the study participants were chosen by stratified sampling (Vilkka, 2015), including age, gender, and employment related factors to represent the demographic structure of the settlement.

### **4.2 Data collection**

The survey was developed for the Nunataryuk project in co-operation with the multidisciplinary research group and it has been pretested in the same region. The survey

was developed in English and translated to Greenlandic for the data collection in Greenland. After pretesting, a couple of alterations were done to the survey questions to enhance cultural and linguistic suitability. The alterations included adding a few options to two multiple choice questions used in the survey. The responses to the open questions were further translated to English for data analysis. Initially, the data were to be collected electronically through online survey, however, as no one responded through the online inquiry, the participants were approached in person by a research team member. Similar problems were witnessed in other field sites with the online survey. Finally, the survey was filled by the study participants themselves in the presence of a member of the research project, also Indigenous Greenlander.

The survey is mainly quantitative but has some open questions. Overall, the survey consisted of 42 questions divided into three themes; first, questions exploring the ecosystem services and social impacts of the environment and related changes; second, questions on use and acquisition of traditional food in the community; and third, questions defining the study participant characteristics and their perception of health and subjective well-being. The data included in the analysis derive mainly from the second and the last themes and comprises of 26 quantitative questions and one fully open question. The quantitative questions include multiple choice, Likert, and Slider's scale type questions, and many also provided possibility for an open answer. The data consists of questions approaching different aspects of traditional food systems in order to capture a holistic picture of the contemporary role of those traditional food systems in the community. These include questions concerning the use of traditional foods in terms of consumption, seasonal variation, and preferred preservation methods; questions related to food acquisition, including subsistence activities and their importance, social aspects in terms of receiving and sharing traditional food items; and changes potentially influencing either the use or acquisition of traditional food.

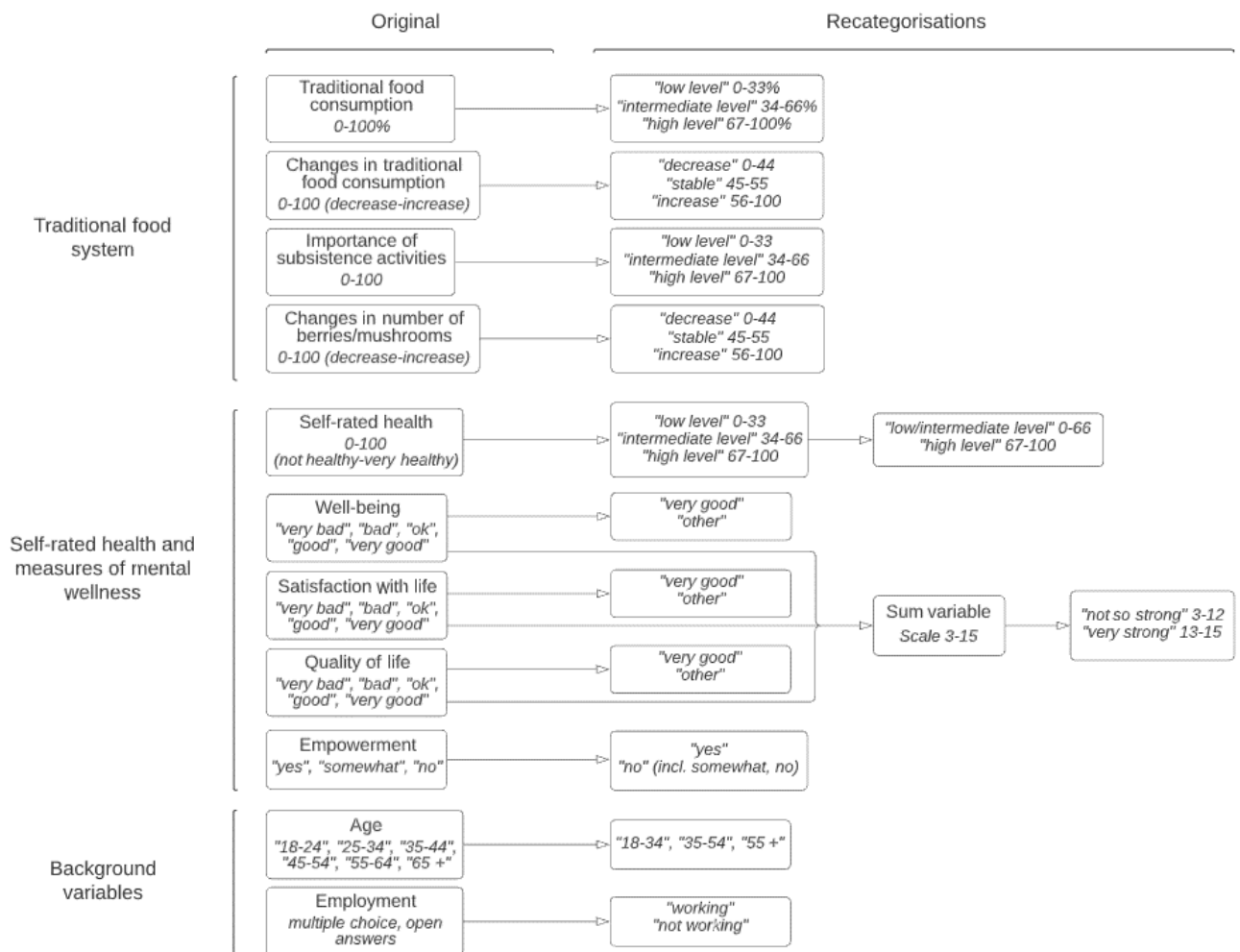
Additionally, the data includes five questions measuring the perception of health, mental wellness, and empowerment of the study participants, from rather holistic point of view. The questions include SRH, subjective well-being, satisfaction with life, quality of life, and feelings of empowerment in relation to the observed changes in the environment. The

measures of perceived health and mental wellness, including well-being, satisfaction with life, and quality of life, were adapted from the SLiCA project (Poppel, 2015).

### 4.3 Study variables

The study variables, used in this study, include variables representing different viewpoints of traditional food systems such as the use and acquisition of traditional foods and related changes, variables measuring perceived health and subjective well-being, and background variables. Some variables were recategorised to enable more various analysis. The recategorisation processes of the altered variables are presented in Figure 3 and the original variables used in the analyses, as they were used in the survey, can be found as an Appendix 1. More detailed descriptions of the original and recategorised variables are provided in the following chapters below.

**Figure 3.** Recategorised study variables and their original forms



#### 4.3.1 Traditional food system

Aspects of the food usage include questions concerning the consumption of traditional food including seasonal variation, and preferred preservation methods. Consumption of traditional food was measured through question regarding whether respondents consume traditional foods on weekly basis and through subjective evaluation of the percentage of country food in the overall diet. The latter question utilised Slider's scale ranging from 0% to 100% and was categorised into three groups: 0-33% for low, 34-66% for intermediate, and 67-100% for high proportion of traditional food items in the overall diet. The seasonal variation was evaluated by asking the most consumed food items for each season separately with a possibility for an open answer. The open answers concerning the seasonal variation in the consumption of traditional food items were categorised as "lamb" for open answers "Greenlandic lamb", as "seafood", including mussels, crabs, and shellfish, and "gathered foods", including different berries, mushrooms, plants, and herbs collected from the local environment.

Variables describing the food acquisition included aspects related to subsistence activities and their importance, main sources of food, and social aspects in terms of sharing and receiving traditional food items. The trends and importance of subsistence activities were evaluated by questions concerning whether the respondents practised hunting and/or fishing, or gathering including picking berries, mushrooms and medicinal plants or foods. The respondents were asked to evaluate the importance of subsistence activities for their household using Slider's scale from 0 (not important) to 100 (very important). The answers were categorised into three categories: 0-33 representing low, 34-66 intermediate, and 67-100 high level of importance.

The data include variables measuring two types of changes related to traditional food systems: the changes in the use of traditional foods and changes in the physical environment affecting subsistence activities. Changes in the use of traditional food was assessed by a question "Has the amount of country food you eat increased or decreased in the past years?" utilising a Slider's scale from 0 to 100, 0 representing and labelled as "decreased", 50 "stable", and 100 "increased". Additionally, an open question provided an opportunity to explain the possible changes in the consumption of traditional food.

Similarly, changes related to the subsistence activities include changes in the number of berries and/or medicinal plants measured by Slider's scale from 0 (decreased) to 100 (increased), with 50 representing no changes or stable situation. Both scales were categorised into three groups where those who answered 45-55 were separated as "stable" indicating no changes in diet or numbers of berries/mushrooms, whereas 0-44 grouped as "decreased", and 56-100 as "increased".

#### 4.3.2 Self-rated health and measures of mental wellness

The participant's perception of their health and mental wellness were assessed through different constituting aspects, including SRH, subjective well-being, satisfaction with life, quality of life, and feelings of empowerment in the face of changes influencing the consumption or acquisition of traditional foods. The term "mental wellness" is used in this thesis as well as in a recently published study by Timlin et al. (2021) deriving from the same set of data. It includes measures of subjective well-being, satisfaction with life, quality of life, and feelings of empowerment.

SRH utilised the Slider's scale ranging from 0 marked as "not healthy" to 100 "very healthy" and 50 marked as "healthy". In turn, subjective well-being, quality of life, and satisfaction with life were all measured using Likert-scale: Very bad, Bad, Ok, Good, Very good, N/A. SRH was categorised into three categories: 0-33 low, 34-66 intermediate, and 67-100 high level of health. The measures of well-being, quality of life, and satisfaction with life were combined using summation to get an additional variable describing the overall level of perceived well-being possible values ranging from 3 to 15. Additionally, the measures of well-being, quality of life, and satisfaction with life were also each individually recategorised into two categories separating the ones who answered "very good" from the others.

In turn, feelings of empowerment were assessed with a multiple choice -question "Do you feel empowered to face these changes?" after questions concerning the changes referred to. The response options were "yes", "somewhat", "no", and were recategorised as "yes" and "no" of which only those who stated "yes" were included in that category, whereas those who replied either "no" or "somewhat" were recategorised as "no".

### 4.3.3 Background variables

Background variables include multiple choice questions defining the age, gender, language, and professional activity of the respondent. Significant proportion of the participants chose a professional activity outside the predetermined options. The professional activity was divided into two categories depending on whether they were actively engaged in working life (public sector, private business, and professional hunter/fisherman) or not (unemployed, retired, student, or homemaker). The open answers provided a variety of different job descriptions and were categorised in similar manner. Additionally, the age was recategorised as “18-34”, “35-54”, and “55 and over”.

## **4.4 Data analyses**

The statistical methods used in this thesis include descriptive methods, crosstabulations, and logistic regression. Additionally, the principles of content analysis were applied to analyse the open answers. All analytical processes are described in detail below. IBM SPSS version 26 software was used for all quantitative data analysis, and Microsoft Office Excel and Word for content analysis and data visualisations. The significance level was set to  $p < 0.05$ . The selected variables and statistical methods used are listed in Table 2 by the research question.

### 4.4.1 Statistical methods

Descriptive methods were used to describe the role of traditional food systems in the community through current practices, their importance, and related changes using both original and modified variables. These methods included distributions, frequencies, and measures of central tendencies. Results are presented as percentages for categorical variables, and as medians (minimum and maximum) for continuous variables due to non-normal distributions. Data visualisations utilise bar charts and tables presented later.

In turn, the relationships between different aspects of traditional food system, focusing on the use and acquisition of traditional foods and related changes, and SRH, subjective

well-being, quality of life, satisfaction with life, and empowerment were inspected as follows. First, crosstabulations were used to analyse these associations when both, dependent and independent variables were categorical. Furthermore, because of the small sample size the dependent variables were used in their recategorised, binary form for all crosstabulations. Different categories of the independent variables were inspected in terms of how many belonged to the group with highest level of well-being, satisfaction with life, quality of life, sum score, and SRH. The statistical inference was measured using Chi-square ( $\chi^2$ ) or Fisher's test.

After crosstabulations, binary logistic regression was used to further analyse the associations between selected variables. Initially, all associations were analysed using univariate logistic regression model and then, adjusted for appropriate background variables. The dependent variables were used in their binary forms with the high level of well-being, satisfaction with life, quality of life, sum score, SRH, and feelings of empowerment as the desired outcome. The independent variables' reference groups were defined to represent the local norm (the most common response option) as seen through the results of the descriptive analyses. Logistic regression was performed on the selected variables regardless of the results of the crosstabulations. However, the predefined criteria for the logistic regression included minimum of five observations per category. Some categories or associations were excluded from the logistic regression analysis due to large number of missing values or too great uniformity in the answers ( $n < 5$ ), and two categories were combined for one variable to enable further analysis. The combination concerned the categories of "low" and "intermediate" levels of traditional food consumption. If the defined criteria were not met, the logistic regression was not performed.

The associations were adjusted for chosen background variables, including age, gender, and employment which are all potentially connected to the traditional food system as well as to the subjective health and mental wellness. Small sample size limited the opportunities in terms of what and how many background variables were possible to adjust for. A forward selection method was used with predefined variables starting from the crude model and adding the variables to adjust for one at a time. The final variables included in the adjusted model were age and gender as employment was not suitable due

to small numbers of observations in many categories ( $n < 5$ ). Similarly, the logistic regression was not performed on the following variables: gathering and quality of life; changes in the number of berries and quality of life; changes in traditional food consumption, SRH, and well-being; and the “increased” category of possible changes in the number of berries/mushrooms, which was therefore excluded from the analyses completely. The results of the logistic regression are presented using forest plots.

**Table 2.** Study questions, main variables, and statistical methods used for the analysis

Research question	Study variables	Statistical methods
1. What is the role of traditional food system and what kind of changes, if any, related to them, have been identified in the community?	<ul style="list-style-type: none"> <li>- Weekly traditional food consumption,</li> <li>- percentage of traditional food in diet,</li> <li>- seasonal variation,</li> <li>- preservation,</li> <li>- hunting/fishing,</li> <li>- gathering,</li> <li>- importance of subsistence activities,</li> <li>- sharing and receiving food,</li> <li>- changes in traditional food consumption and related reasons,</li> <li>- changes in number of berries/mushrooms</li> </ul>	Descriptive methods: <ul style="list-style-type: none"> <li>- medians,</li> <li>- frequencies,</li> <li>- distributions</li> </ul> Qualitative methods: <ul style="list-style-type: none"> <li>- content analysis</li> </ul>
2. Are there associations between traditional food systems, related changes, and SRH, subjective well-being, quality of life, satisfaction with life, and feelings of empowerment?	<ul style="list-style-type: none"> <li>- Percentage of traditional food in diet</li> <li>- hunting/fishing,</li> <li>- gathering,</li> <li>- changes in traditional food consumption,</li> <li>- changes in number of berries/mushrooms,</li> <li>- SRH</li> <li>- well-being</li> <li>- satisfaction with life</li> <li>- quality of life</li> <li>- sum variable of well-being, satisfaction with life, and quality of life</li> <li>- feelings of empowerment</li> </ul>	Methods for measuring association: <ul style="list-style-type: none"> <li>- crosstabulation</li> <li>- logistic regression</li> </ul>

#### 4.4.2 Content analysis

The data also included some open answers not suitable for quantitative methods as such. Content analysis serves as a flexible method used to analyse written, verbal, or visual communication messages aiming to describe and quantify a phenomenon of interest in



objective and systematic manner (Elo & Kyngäs, 2008). All open answers were analysed by applying the principles of the content analysis as overall, the responses were sparse ranging from only single word answers to couple of sentences. The principles of content analysis were applied to recognise reoccurring words or concepts within the open answers and further categorise and quantify them. For questions providing open answer possibility to a multiple choice question the answers were simply categorised and reported alongside with the predefined categories. In turn, the one fully open question providing an opportunity for the respondents to describe reasons behind possible changes in the consumption of traditional foods, was approached following the principles of inductive content analysis to analyse the manifest content of the responses. Reoccurring words and concepts were identified and grouped together, and further categorised to represent the variety of reasons brought up by the respondents. The aim was to identify and develop better understanding of possible reasons behind the changes in traditional food consumption in the community. Noteworthy, authentic citations are not provided to protect the identity of the respondents.

#### **4.5 Ethical considerations**

This thesis is a part of an international research project Nunataryuk and the data was collected as part of the project. The project is a multidisciplinary by nature, led by social scientists. The research plan did not meet the criteria of medical research thus, did not require ethical review of human sciences for the data collection at the time locally nor according to the Finnish National Board on Research Integrity TENK (2019). However, the research team focusing on the aspects related to mental wellness, received an ethical approval from the Health Research Ethical Committee in Greenland for further research (Timlin et al., 2021). Additionally, to protect the anonymity of the community and the study participants, the exact location of the research is not revealed.

Furthermore, research involving Indigenous people has certain special considerations, for example, in relation to research exhaustion. Therefore, the research needs to be designed and carried out with sensitivity and respect. (WHO, 2003; Drugge, 2016; Willows, 2017.) To respect these parameters, the data were collected with a single survey to serve the purpose of various research groups working in different fields of expertise, instead of

burdening the community with a number of different means and occasions of data collection. Furthermore, the community members were met with respect and involved throughout the project rather than treated as passive sources of information serving solely the interest of the researchers. In addition, the participation to the study was fully voluntary and an informed consent was signed by the participants prior to data collection.

The data were provided by the University of Oulu and was stored and handled carefully throughout the thesis process to maintain confidentiality. Furthermore, after finalising the thesis, the data were destroyed. Overall, I have attempted to maintain transparency throughout the research process and to present my findings with integrity and honesty.

## 5. RESULTS

### 5.1 Study participant characteristics

The characteristics of the study participants are presented in Table 2. The gender division was relatively even as from the total of 100 participants 48% were male and 52% female. Age of the study participants varied between 18 and 65 or over with majority (39%) between 35 and 54 years old. Greenlandic was the most spoken language by 90% of the study participants, whereas Danish or a combination of both were spoken by the rest. The variation in the professional activities practiced by the participants is described in Table 3. Overall, majority of the participants were working.

**Table 3.** Characteristics of the study participants (N=100)

Characteristics	n (%)
<b>Gender</b>	100 (100)
Male	48 (48)
Female	52 (52)
<b>Age</b>	100 (100)
18-34	30 (30)
35-54	39 (39)
55 +	31 (31)
<b>Language</b>	100 (100)
Greenlandic	90 (90)
Danish	5 (5)
Other	5 (5)
<b>Professional activity</b>	100 (100)
Public sector	23 (23)
Private sector	8 (8)
Professional hunter/fisherman	11 (11)
Unemployed	2 (2)
Retired	7 (7)
Student	8 (8)
Homemaker	2 (2)
Other	39 (39)
<b>Professional activity categorised</b>	100 (100)
Working	80 (80)
Not working	20 (20)

## 5.2 The role of traditional food systems in the community

### 5.2.1 Food usage

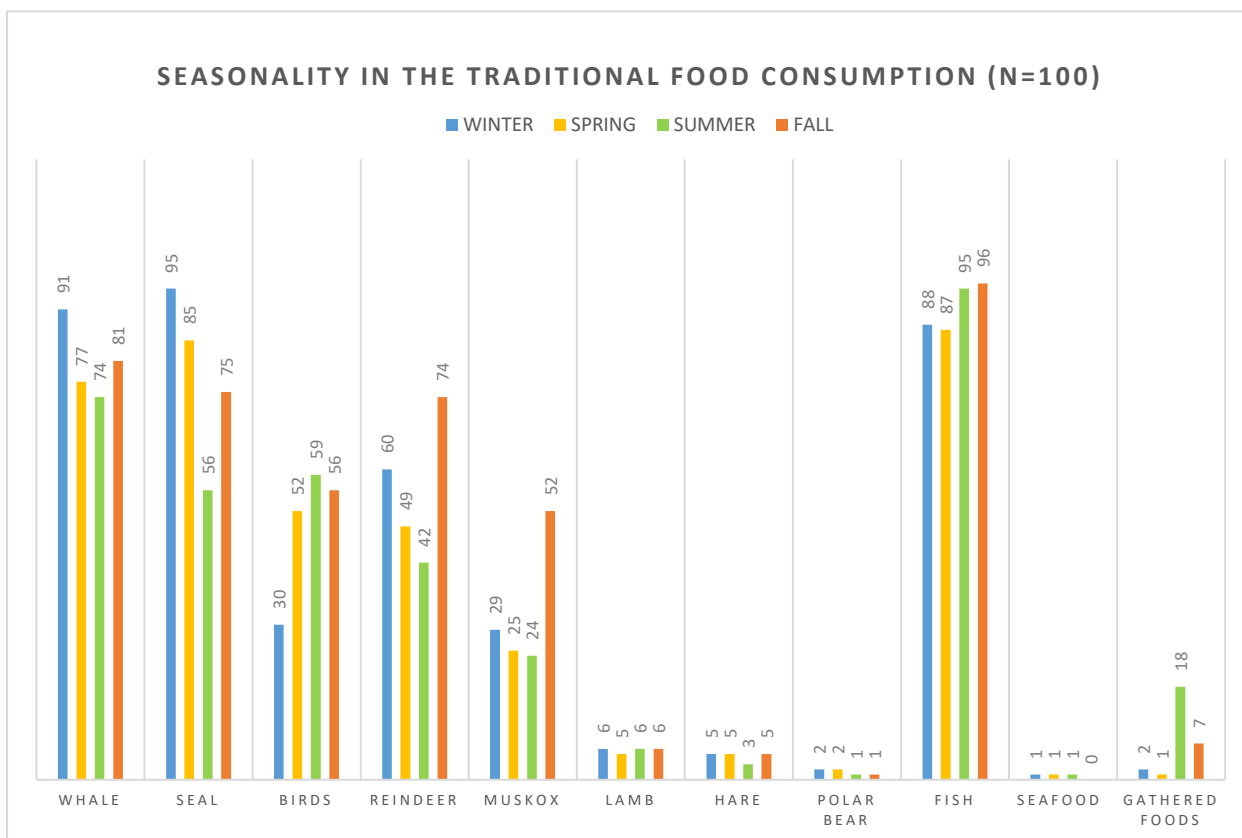
The variables describing the use of traditional food are presented in Table 4. Traditional food was consumed by 97% of the participants on weekly basis. The self-evaluated proportion of traditional food intake in overall diet had median percentage of 69 (min. 5, max. 100), the highest number of participants (n=31) reported to consume 80% or more traditional foods in their diet. In contrast, only two participants evaluated that proportion to be less than 20%, whereas the majority fell in between these opposing categories.

**Table 4.** Use of traditional food in the community (N=100)

Parameters	n (%)
<b>Country food consumption at least once per week</b>	100 (100)
Yes	97 (97)
No	3 (3)
<b>Evaluated percentage of country food in diet</b>	100 (100)
< 20%	2 (2)
20-39%	16 (16)
40-59%	26 (26)
60-79%	25 (25)
80% or over	31 (31)
<b>Preferred preservation methods</b>	
Freezer	99 (100)
1. option	92 (92.9)
2. option	6 (6.1)
3. option	1 (1.0)
Dried and/or smoked	81 (100)
1. option	5 (6.2)
2. option	69 (85.2)
3. option	7 (8.6)
Ice storage	68 (100)
1. option	2 (2.9)
2. option	6 (8.8)
3. option	60 (88.2)

The preferences in the preservation methods were rated from most preferred option to least preferred option by the respondents. Freezer was clearly the most preferred preservation method as 92 respondents chose it as the primary option, followed by drying and/or smoking which was chosen as the second option by 69. Whereas ice storage was rated as the least preferable, chosen by most (n=60) as the third option.

**Figure 4.** Number of respondents indicating mostly used traditional foods per season.



Seasonal variation in the consumption of different country food items is presented in Figure 4. Seasonality in the use of different foods was evident, for some food items more than the others; terrestrial animals including reindeer and muskox were consumed in fall more often than other seasons; seal in winter and spring; birds in spring, summer, and fall; gathering of berries, mushrooms, plants, and herbs were most common in summer. Whereas the consumption of whale and fish remained high but stable, and hare, lamb, seafood, and polar bear low but stable, throughout the year. Overall, whale, seal, and fish remained most, and polar bear and seafood least commonly consumed despite the season.

### 5.2.2 Food acquisition

The characteristic and importance of traditional food systems in terms of food acquisition in the community are presented in Table 5. Subsistence activities were frequently practiced in the community, and the local environment appears to be an important source of food. 64% of the participants reported to either fish or hunt, and 82% gathered foods from the local environment. The results for the major source of food in the past week

were quite evenly distributed between the supermarket, the land, and family or friends. Overall, the subsistence activities have great importance to the participants and their households when evaluated on the scale between 0 and 100 (median of 88, min. 27, max. 100). Indeed, 90.7% of the respondents had considered subsistence activities to have high level of importance to their household, in contrast to 8.2% considering the level of importance as intermediate, and only 1% as low.

**Table 5.** The acquisition of traditional food in the community (N=100)

Parameters	n (%)
<b>Importance of subsistence activities for household</b>	97 (100)
Low	1 (1.0)
Intermediate	8 (8.2)
High	88 (90.7)
<b>Hunt or fish</b>	100 (100)
Yes	64 (64)
No	36 (36)
<b>Gathering</b>	100 (100)
Yes	82 (82)
No	18 (18)
<b>Main source of food in the past week</b>	100 (100)
Supermarket	34 (34)
Land (including frozen or preserved foods)	33 (33)
Local shop (brættet)	2 (2)
Family members or friends	31 (31)
<b>Receiving traditional food</b>	100 (100)
Yes	90 (90)
No	10 (10)
<b>If yes, how often</b>	91 (100)
Once a week	11 (12.1)
Two times per month	11 (12.1)
Once a month	12 (13.2)
Few times a year	44 (48.4)
Once a year	13 (14.3)
<b>Sharing traditional food</b>	100 (100)
Yes	88 (88)
No	12 (12)

Additionally, sharing and receiving traditional food items remain common practices in the community. 90% of the participants receive country food from family, friends, and/or as a donation, and 88% in turn share country food with other households in the community. Nearly half of the respondents received country food few times a year, whereas the rest of the answers spread quite evenly.

### 5.2.3 Related changes

Overall, the consumption of traditional food has remained somewhat stable. Majority of the respondents, 53.1%, considered their consumption to have stayed stable, whereas 22.4% of the respondents thought their consumption to have decreased and 24.5% it to have increased (n=98, 100%). The reported reasons behind the changes were categorised as environmental, structural/institutional, and social reasons further described as “external reasons”, and personal, or “internal reasons”. All categories included responses explaining decreases as well as increases in the consumption of traditional food items. However, internal reasons, including those related to personal preferences, perceptions, and resources, were more commonly identified as reasons for an increase and external reasons more often as reasons for a decrease in the consumption. Notably, social reasons were quite evenly described as a reason for changes in the consumption to both directions. The categories and sub-categories are presented in Figure 5.

**Figure 5.** Categories and sub-categories of reasons behind changes in the consumption of traditional food



The respondents had found the numbers of berries, mushrooms, and/or medicinal plants in the best picking spots clearly decreasing. Approximately half (53.8%) reported a decrease in the number of berries and/or plants, and only 3.8% had observed an increase in the numbers (n=80, 100%).

## 5.3 Traditional food system and measures of health and mental wellness

### 5.3.1 Self-rated health and mental wellness in the community

The parameters measuring different aspects of perceived health and well-being of the participants living in the community are presented in Table 6 below. Overall, the respondents viewed their subjective health and mental wellness consistently relatively highly.

**Table 6.** Dependent variables (N=100)

Parameters	n (%)
<b>Well-being</b>	99 (100)
Very bad/Bad/Ok	14 (14.1)
Good	57 (57.6)
Very good	28 (28.3)
<b>Quality of life</b>	99 (100)
Very bad/Bad/Ok	8 (8.1)
Good	70 (70.7)
Very good	21 (21.2)
<b>Satisfaction with life</b>	99 (100)
Very bad/Bad/Ok	3 (3)
Good	58 (58.6)
Very good	38 (38.4)
<b>Summation of well-being, quality of life, and satisfaction with life</b>	99 (100)
Not so strong	53 (53.5)
Very strong	46 (46.5)
<b>Self-rated health</b>	99 (100)
Low level	7 (7.1)
Intermediate level	69 (69.7)
High level	23 (23.2)
<b>Feelings of empowerment to face changes</b>	94 (100)
No	13 (13.8)
Somewhat	27 (28.7)
Yes	54 (57.4)

The results from the scale of SRH had a median of 50, i.e., “healthy” (min. 17, max. 100). Majority, 69.7% of the respondents fell into the category of intermediate level of health and clear minority, only 7.1% low level of health. Subjective well-being, quality of life, and satisfaction with life were all relatively highly rated among the participants; most rated all three as “good”, followed by “very good”. The sum variable measuring mental wellness by combining the values from all three had a median of 12 (min. 7, max. 15) on the range from lowest possible value of three to highest possible value of 15. Most



respondents reported to have feelings of empowerment to face changes observed in the community potentially influencing their traditional food systems. These parameters describing the subjective health and mental wellness are not further evaluated, analysed, nor discussed separately but are rather utilised in relation to the traditional food system in the community.

### 5.3.2 Associations between traditional food system, self-rated health, and mental wellness

The results of the crosstabulations of all selected variables are presented in Table 7. Hunting and/or fishing was statistically significantly associated with the sum variable ( $p=0.027$ ) as those who did hunt and/or fish had more frequently very strong sum score (54.7%) compared to those who did not (31.4%). Similarly, from the components of the sum score, having a very good quality of life and very good satisfaction with life were associated with hunting and/or fishing, however, these associations were not statistically significant. Gathering was not found to have statistically significant associations with well-being, satisfaction with life, quality of life or their sum score. Although interestingly, gathering was inversely associated with well-being as those who did not practice gathering had more frequently very good well-being (44.4%) compared to those who did not (24.7%). However, the association did not reach statistical significance ( $p=0.092$ ).

Nevertheless, similarly, gathering was statistically significantly associated with lower levels of SRH as 44.4% of those who did not practice gathering had high level of SRH compared to 18.5% of those who did ( $p=0.018$ ). Interestingly however, gathering was simultaneously positively associated with feelings of empowerment ( $p=0.010$ ). Furthermore, changes in the number of berries and/or mushrooms were statistically significantly associated with satisfaction with life ( $p=0.006$ ), quality of life ( $p<0.001$ ), and the sum score ( $p=0.011$ ) as those who reported that the numbers had remained stable or increased, had more frequently evaluated all three higher than those who reported decrease in the numbers. There were no statistically significant associations between traditional food consumption, changes in traditional food consumption, changes in the environment and any of the measures of well-being.

Similar patterns were present in the results of the logistic regression analyses. Those results, concerning the use and acquisition of traditional food and related changes, are illustrated in Figure 6. Traditional food consumption was not significantly associated with any of the dependent variables. Hunting and/or fishing continued to be significantly associated with the sum variable (unadjusted OR 0.38, CI 0.16-0.91,  $p=0.029$ ); those who did not hunt and/or fish had lower odds of having a very strong sum score compared to those who did. The association appeared stronger after adjusting for age and gender (OR 0.27, CI 0.10-0.77,  $p=0.015$ ). Similarly, those who did not hunt and/or fish had lower odds of having a very high satisfaction with life compared to those who did in the adjusted model (OR 0.34, CI 0.12-0.97,  $p=0.043$ ) unlike in the unadjusted model or in crosstabulations. Gathering continued to have adverse association with SRH as those who did not practice gathering had over three times higher odds of having evaluated their SRH high (unadjusted OR 3.52, 1.19-10.42,  $p=0.023$ ), the association was found weaker after adjusting for age and gender yet, it did remain significant (OR 3.17, CI 1.01-9.96,  $p=0.048$ ). In turn, those who did not practice gathering were less likely to have feelings of empowerment both in the unadjusted model (OR 0.24, CI 0.08-0.75,  $p=0.014$ ) and the adjusted model (OR 0.35, CI 0.13-0.96,  $p=0.041$ ).

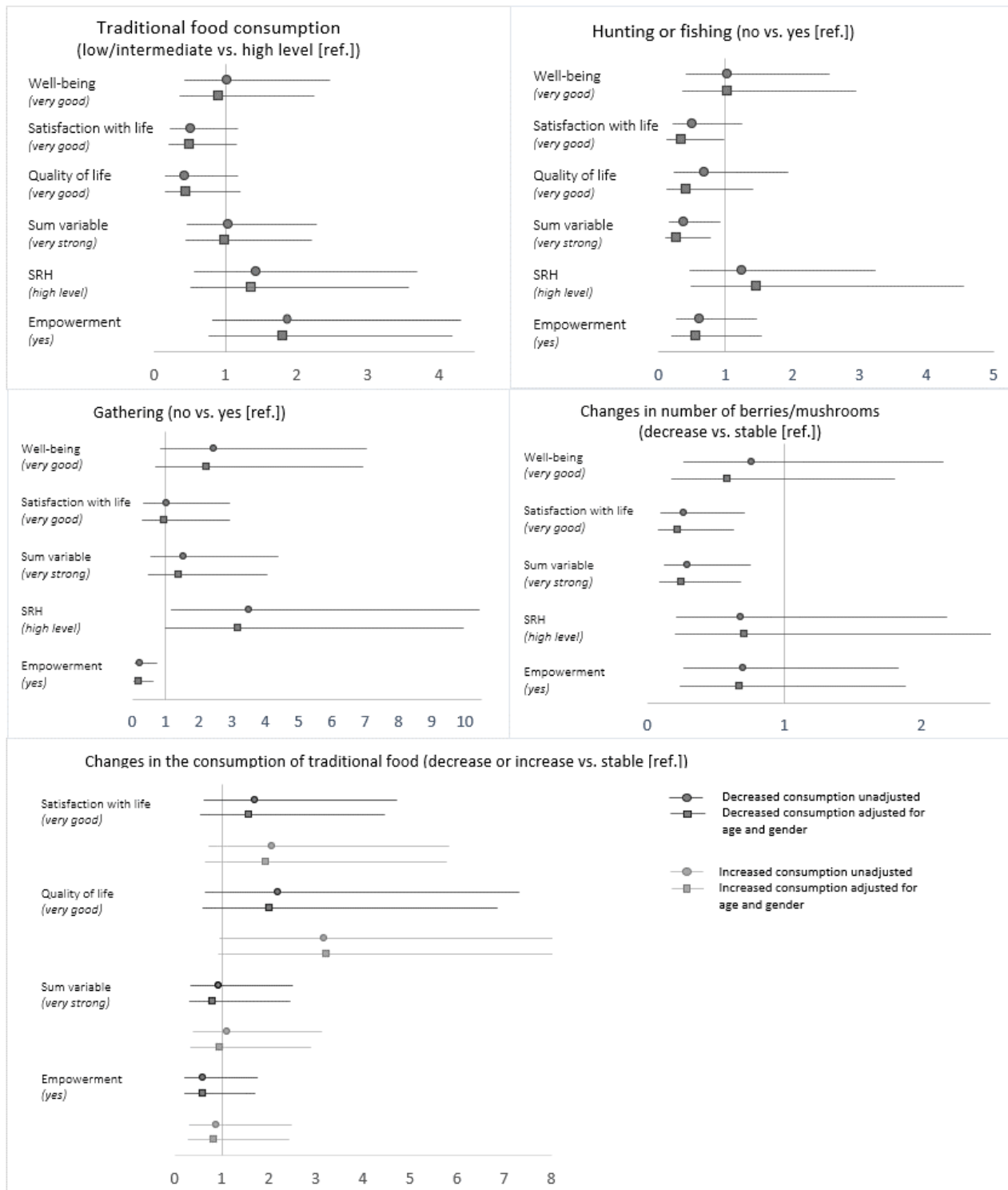
Changes in the traditional food consumption were not associated with any of the dependent variables regardless of the direction of the change. Notably, those who reported an increase in their consumption of traditional food seemed to have higher odds of having very good quality of life in the unadjusted (OR 3.16, CI 0.97-10.35,  $p=0.057$ ) and the adjusted (OR 3.23, CI 0.94-11.19,  $p=0.064$ ) models yet, these associations did not reach statistical significance. In turn, a decrease in the number of berries and/or mushrooms was associated with lower odds of having very good satisfaction with life (unadjusted OR 0.23, CI 0.09-0.63,  $p=0.004$ ; adjusted OR 0.19, CI 0.07-0.60,  $p=0.002$ ) and very strong sum score (unadjusted OR 0.25, CI 0.09-0.66,  $p=0.005$ ; adjusted OR 0.20, CI 0.07-0.57,  $p=0.003$ ) compared to those who had reported stability in the numbers.

**Table 7.** Participants with very good well-being, satisfaction with life, quality of life, very strong sum score, high level of SRH, and positive feelings of empowerment by variables of traditional food system and related changes.

	Very good well-being (n=99)	p	Very good satisfaction with life (n=99)	p	Very good quality of life (n=99)	p	Very strong sum score (n=99)	p	High level of SRH (n=99)	p	Feelings of empowerment (n=94)	p
<b>Traditional food consumption (n=99)</b>												
High level	14 (28.0)	0.752	23 (46.0)	0.192	14 (28.0)	0.053	23 (46.0)	0.961	10 (20.0)	0.641	24 (50.0)	0.317
Intermediate level	10 (32.3)		8 (25.8)		2 (6.5)		15 (48.4)		9 (29.0)		20 (66.7)	
Low level	4 (22.2)		7 (38.9)		5 (27.8)		8 (44.4)		4 (22.2)		10 (62.5)	
<b>Hunting/fishing (n=99)</b>												
Yes	18 (28.1)	0.962	28 (43.8)	0.138	15 (23.4)	0.464	35 (54.7)	<b>0.027</b>	14 (21.9)	0.665	37 (61.7)	0.272
No	10 (28.6)		10 (28.6)		6 (17.1)		11 (31.4)		9 (25.7)		17 (50.0)	
<b>Gathering (n=99)</b>												
Yes	20 (24.7)	0.092	31 (38.3)	0.961	18 (22.2)	0.602	36 (44.4)	0.393	15 (18.5)	<b>0.018</b>	49 (63.6)	<b>0.010</b>
No	8 (44.4)		7 (38.9)		3 (16.7)		10 (55.6)		8 (44.4)		5 (29.4)	
<b>Changes in traditional food consumption (n=97)</b>												
Decreased	4 (18.2)	0.442	10 (45.5)	0.315	6 (27.3)	0.119	10 (45.5)	0.957	3 (13.6)	0.441	10 (50.0)	0.654
Stable	18 (32.7)		18 (32.7)		8 (14.5)		26 (47.3)		15 (27.3)		31 (62.0)	
Increased	6 (30.0)		10 (50.0)		7 (35.0)		10 (50.0)		5 (25.0)		13 (59.1)	
<b>Changes in number of berries/mushrooms (n=79)</b>												
Decreased	10 (22.2)	0.841	11 (24.4)	<b>0.006</b>	3 (6.7)	<b>&lt;0.001</b>	14 (31.1)	<b>0.011</b>	7 (15.6)	0.639	26 (60.5)	0.320
Stable	9 (27.3)		18 (54.5)		13 (39.4)		20 (60.6)		7 (21.2)		22 (68.8)	
Increased	0 (0.0)		1 (100.0)		1 (100.0)		1 (100.0)		0 (0.0)		0 (0.0)	

N=100, the total number of participants, n=number of corresponding answers, frequencies in percentages, n (%). Bolding highlights statistical significance (p < 0.05)

**Figure 6.** Forest plots illustrating the unadjusted (round) and age- and gender-adjusted (square) odds ratios and 95% confidence intervals for each measure of well-being by the level of traditional food consumption, subsistence activities, and related changes.



## **6. DISCUSSION**

### **6.1 The main results of the study**

The results of this study indicate the importance of the traditional food system in the community: nearly all reported to consume traditional foods on weekly basis and considered subsistence activities as very important for their households; self-estimated proportion of traditional food in overall diet was high (median 69%); and a clear majority practiced hunting and/or fishing and gathered foods from their local environments, 64% and 82%, respectively.

The results of this study in terms of the possible associations between different aspects of traditional food system, SRH, and mental wellness were more complex. This study did not find any significant associations between the consumption of traditional food or changes in it and any measures of subjective health and mental wellness. In turn, the results suggested subsistence activities and related changes to have clearer association: hunting and/or fishing was significantly associated with very strong sum score and thus, seemed to support mental wellness. Interestingly, gathering was inversely associated with SRH, although the association became weaker in the adjusted model. In turn, observed decrease in the number of berries and mushrooms was inversely associated with satisfaction with life, quality of life, and the sum variable.

### **6.2 The role of traditional food system in the community**

As mentioned before, overall, the results of this study suggest that the traditional food system continues to have an important role in the community. Interestingly, although the regional differences in traditional food consumption have been discussed in previous research suggesting the consumption of traditional foods to be higher in rural regions (Bjerregaard et al., 2001; Milman et al., 2010), the estimated proportion of traditional foods in overall diet were significantly higher compared to the results from previous studies conducted around Greenland (Baines et al., 2015; Jeppesen & Bjerregaard, 2012; Terkelsen et al., 2018). Naturally, there is variation in the regional focus and study participant characteristics between different studies. Also, importantly, majority of the other studies have evaluated the proportion as a percentage of

total energy intake from traditional food items by using Food Frequency Questionnaires (Bjerregaard & Jeppesen, 2010; Jeppesen & Bjerregaard, 2012; Terkelsen et al., 2018) or other validated food questionnaires commonly used in the context of Greenland (Baines et al., 2015). This study relied on subjective estimates of the consumption and did not provide a time frame for the respondents. Therefore, the results are not directly comparable with each other. Additionally, the consumption of other food items was not included in the questionnaire and thus, no comparisons could be made between the importance of and reliance on the traditional food system and the intake of imported foods. However, the main source of food for the past week was relatively equally divided between the options of supermarket, land, and family and friends.

Seasonal variation in the use of different foods was evident in the results, for some more than the others. Overall, whale, seal, and fish remained most, and polar bear and seafood least commonly consumed despite the season. Similarly, previous studies have highlighted the role of marine mammals in traditional diet (Baines et al., 2015; Jeppesen & Bjerregaard, 2012; Sowa, 2015). In addition to the seasonality in the consumption, the presence of seasonal variation aligns with the importance of the season in terms of subsistence activities contributing to the building of knowledge and understanding of the local environment (Tejsner, 2013) and to the broader concept of traditional food systems of Indigenous peoples highlighting the connection with the environment (Kuhnlein et al., 2009, 2013). Also, seasonality in the availability and variation in the imported food items has been discussed in previous literature with smaller, rural settlements having clearly more limited access to fresh foods (Bjerregaard & Mulvad, 2012; Watson, Shanks et al., 2018). Question remains how much variation there is in the intake of traditional and imported food items also seasonally, and how that may interplay with the health effects.

Majority of the respondents reported to share and receive traditional foods from friends and family members or as a donation. Similarly, social factors were also discussed as reasons for an increase as well as a decrease in the consumption of traditional foods. The notion of strong social importance related to the traditional food systems is in line with previous research conducted in Greenland (Sowa, 2015; MacDonald et al, 2013) as well as in relation to the traditional food systems of Indigenous peoples in general (Kuhnlein et al., 2009, 2013).

Besides social reasons, other external reasons behind changes in the consumption of traditional foods included environmental reasons such as changed weather conditions either challenging hunting activities or described as beneficial, and changes in the number of berries, fish, and animals observed or caught. The reasons described by the respondents relate to challenges described in previous studies (Ford et al., 2018; Ford & Goldhar, 2012; Hendriksen & Jørgensen, 2015; Tejsner, 2013; Tejsner & Veldhuis, 2018). Also, structural, or institutional reasons were mentioned by some respondents, including high prices of imported foods and regulations restricting hunting and fishing activities. Ford and Goldhar (2012) discuss the combination of environmental pressure and governmental regulation on subsistence activities constraining the capacities of locals to adapt. Additionally, internal, or personal reasons were described as reasons for both increase and decrease in the consumption of traditional food items. Limited resources often resulted in decreased consumption, whereas personal preferences, and perceived healthiness of food were described as reasons behind increased consumption similarly to the findings of Sowa (2015) and Watson, Miles et al. (2018).

Overall, despite the ongoing sociocultural changes resulting in a shift away from the traditional lifestyle and changes in the physical activity patterns related to subsistence activities, a clear majority practiced subsistence activities to harvest food from their local environments (Dahl-Petersen et al., 2011; Sowa, 2015; Watson, Miles et al., 2018). Also, nearly all considered subsistence activities as very important for their households. In the context of Greenland, the importance of subsistence activities is in line with previous research suggesting them to have great economic, social, and cultural importance particularly for the Indigenous people, and to continue to be commonly practiced especially in rural regions (AMAP, 2017a; Poppel, 2015; Sowa, 2015). Additionally, approximately half reported a decrease in the number of berries, mushrooms, and/or medicinal plants in their local environments. Such changes were also noted as reasons for a decreased traditional food consumption. Noteworthy, very little was found in the literature concerning the role of gathering in the context of traditional food systems in Greenland.

### **6.3 Traditional food system, self-rated health, and mental wellness**

Previous studies evaluating the association between traditional food systems and health tend to focus on rather objective measures of health and with emphasis on the

consumption of traditional food. Consequently, studies evaluating the relationship while utilising indicators to measure subjective experience of health and mental wellness, as well as studies approaching traditional diet from systems approach or focusing on other aspects besides the consumption, remain limited. Also, to my knowledge, no prior studies have measured the feelings of empowerment in relation to traditional food systems and related changes in Greenland. Importantly, as mentioned in the literature review, the evidence on the association between traditional food systems and health in Greenland has yielded conflicting results and traditional food seems to have simultaneous health risks and benefits. Similarly, the results from this study were inconclusive.

Contrary to expectations, this study did not find any significant associations concerning the association between the consumption of traditional food or changes in it and subjective health and mental wellness. However, the concerns over the health risks related to the consumption of traditional food in Greenland, did not manifest in the results of this study, as the overall consumption of traditional food was high alongside with consistently high levels of SRH and mental wellness in the community overall. This aligns with previous literature discussing the importance of traditional food and related practices for Indigenous peoples themselves (Egeland et al., 2009; Kuhnlein et al. 2009, 2013), on some occasions even despite the concerns raised by others as discussed in the context of Greenland and in relation to the “Arctic dilemma” (AMAP, 2015, p. 111; Bjerregaard & Mulvad, 2012). Additionally, in this study, some respondents noted health as a reason to rather increase the intake of traditional food than decrease it. Similarly, Sowa (2015) and Watson, Miles et al. (2018) discuss the personal preferences in taste and perception of traditional food as healthier compared to imported foods as reasons to prefer traditional foods over imported foods.

Although associations between traditional food consumption, SRH, and mental wellness remained unestablished, the results suggested subsistence activities and related changes to have clearer relationship. Hunting and/or fishing was significantly associated with very strong sum score in all models and thus, seemed to support mental wellness. However, hunting and/or fishing was not significantly associated with the components of the sum score - well-being, satisfaction with life, and quality of life – when inspected individually, besides slight positive association with satisfaction with life after adjusting for age and



gender. Overall, this supports the notion of subsistence activities as beneficial for health (Dahl-Peterson et al., 2011, 2013, 2017; Munch-Andersen et al., 2012) and their economic, social, and cultural importance (Larsen & Fondahl, 2014; MacDonald et al., 2013; Poppel, 2015), especially in relation to the Indigenous peoples and their traditional food systems. Furthermore, the connection between satisfaction with life and hunting and/or fishing was also discussed by Poppel (2015) in terms of SLiCA indicators used among Indigenous peoples around Arctic; satisfaction with life as a whole was found to correspond mostly with satisfaction with opportunities to hunt and fish, among else, (pp. 63-64). Additionally, Eliassen et al. (2012) identified a shift away from traditional lifestyle as a risk factor for poorer SRH in Greenland and McDonald et al. (2013) reported subsistence activities enhance connection with environment and be associated with self-reliance, mindfulness, self-confidence, awareness of the consequences of one's actions, and a sense of purpose (p. 7). Noteworthy, oftentimes subsistence activities in literature focus on hunting and fishing activities.

Interestingly, gathering was inversely associated with SRH, although the association became weaker in the adjusted model. Traditionally, gathering has been practiced majorly by women and the association may have confounding factors not included in the analysis. For example, SRH includes the notion of physical health and could be associated with shorter time span state compared to the measures of mental wellness, of which especially satisfaction with life has been discussed as intuitively referring to the overall experience of life rather than momentary feelings (OECD, 2013). As discussed before, this study did not utilise nor inquired any information concerning the physical health of the respondents. Furthermore, SRH as well as all the measures of mental wellness utilised in this study are, indeed, subjective and may be interpreted differently by the respondents, especially when acknowledging the potential differences in the perspectives on health and well-being with Indigenous understanding encompassing often broader aspects, including the holistic nature of individual health, as well as the importance of the community, and the interconnectedness of the health of the people, wildlife, and the environment (Hueffer et al., 2019; Yadeun-Antuñano, 2019).

Besides the inverse association with SRH, gathering was simultaneously positively associated with feelings of empowerment supporting the findings of MacDonald et al.

(2013) as discussed before in relation to hunting and fishing. Additionally, observed decrease in the number of berries and mushrooms was inversely associated with satisfaction with life, quality of life, and the sum variable. This may connect to the vulnerabilities related to environmental changes threatening the knowledge of the local environment (Ford & Goldhar, 2012) and connection with nature (MacDonald et al., 2013) that have been discussed in relation to subsistence activities, although, mostly in relation to fishing and hunting rather than gathering. In fact, as mentioned before, there is little, if any, discussion concerning gathering, related changes, and health in the context of Greenland.

Noteworthy, as mentioned before, the respondents viewed their subjective health and mental wellness consistently relatively highly overall. The recent article by Timlin et al. (2021) discusses the components of mental wellness, including well-being, satisfaction with life, and quality of life as experienced in the community in more detail. Similarly to the findings of this study, they found spending time in nature in various activities, including hunting and fishing, to increase mental wellness, whereas gathering decreased the likelihood of very good well-being (Timlin et al., 2021).

#### **6.4 Strengths and limitations**

This study provides a good opportunity to deepen the understanding on the subjective experience of the local people concerning their traditional food system. Oftentimes the previous research has focused on the objective measures of health and placed less emphasis on the subjective measures of health and mental wellness. In turn, this study aimed to bring forth the local peoples' own voices and experiences complementing and building upon the previous research on the topic. Overall, the results of this study suggest the traditional food system to have an important role to the community members themselves. Indeed, by relying on estimations of the community members and providing them an opportunity to express their perspectives related to the traditional food system, this study provides valuable insight on the topic instead of focusing on objective measurements that cannot necessarily bring out the subjective experience of the importance as well.

Furthermore, simultaneously, this study provides information on the subjective health and mental wellness in the community that should be examined alongside the role of traditional food system; the respondents viewed their subjective health and mental wellness consistently relatively highly overall in a community with high level of consumption of traditional food, and subsistence activities were commonly practiced and viewed very important. Acknowledgement of such combination is important especially when the focus is often on the concerns over the sociocultural changes and environmental threats affecting the traditional lifestyles, especially in rural regions in Greenland and around the Arctic in general. Additionally, in relation to methodology, the use of several different measures for subjective health and mental wellness provided a comprehensive picture of the well-being of the community members, instead of relying only on single measures. Also, the participation rate in the study was high as only few refused to participate and a total of 100 agreed.

Importantly, there are some limitations to the study. A relatively small sample size and uniformity in the answers limited the possibilities for statistical analysis and influenced the statistical power and thus, reliability and generalisability of the results. Therefore, for example, multivariate analyses with more adjustments were not feasible due to which employment as a possible confounder was not included in the analyses. Similarly, all associations were not possible to analyse using logistic regression. Also, small sample size was also evident in the broad confidence intervals. Overall, no conclusions of the causality of the associations may be drawn due to the cross-sectional study design.

Additionally, no data were collected on the objective health status potentially influencing the subjective experience of health and mental wellness as well as different aspects of traditional food system. The latter include, for example, the consumption of imported food items, as personal health reasons were noted by few respondents as a reason for an increase of traditional food consumption, and subsistence activities in terms physical fitness. Furthermore, this study did not provide a time frame for the respondents nor assessed the consumption of other food items challenging the comparability with other studies. Importantly, the data relied on subjective, self-reported estimates of different aspects of traditional food system and thus, possibly exposed to bias. Although, simultaneously, the topic of interest is evidently very complex and therefore

unsurprisingly, the results were inconclusive and could be characterised with uncertainty. Indeed, due to the complexity of the topic other unknown or unaccounted confounders may influence the internal validity of the results. However, despite the limitations related to the methodology and sample size, the subjective estimations do provide evidence suggesting traditional food systems to be considered important in the community and contribute to the subjective health and mental wellness.

Noteworthy, as discussed before, the indigeneity of the respondents was not separately inquired in the survey which, therefore, remains uncertain. However, generally, over 90% of the population in Greenland are born in Greenland, and majority of migrants come from Denmark (Statistics Greenland, 2020). These population statistics suggest that most of the study respondents were also indeed Indigenous Greenlanders. This is further supported by the language information, if considered as a proxy for ethnicity, collected in the survey: 90% of the participants spoke Greenlandic at home, 5% Danish, and 5% combination of both. The importance of traditional food systems and related health effects have been discussed mostly in relation to Indigenous peoples, especially in terms of subjective measures of health and mental wellness suggesting the positive influence to stem from cultural importance, social cohesion, ethnic identity and pride, among else (MacDonald et al., 2013). However, despite the uncertainty over the indigeneity and small sample size, the study population represented the community itself well and, similarly, potentially other rural communities in Greenland, especially in the same region, that can be characterised with more traditional ways of living. Nonetheless, as Greenland is undergoing sociocultural transition that occurs in different stages in different regions, the generalisability of the study results to the overall population, remain weak.

## **6.5 Recommendations**

As this study did not confirm the indigeneity nor could adjust for language, more research could be done to examine possible differences concerning the role of traditional food system and related associations on health and mental wellness between the Indigenous and other people living in Greenland. Similarly, the role of traditional food system in terms of subjective health and mental wellness could be further studied elsewhere around Greenland and the Arctic among Indigenous peoples. More research could be also done

comparing the traditional food system and the role of imported food in relation to the subjective health and mental wellness to deepen the understanding of the impacts of sociocultural transition. Furthermore, the role of gathering and related changes remains very limited in the previous literature and could be further examined in the context of Greenland, especially concerning the conflicting results related to the associations between gathering, SRH, and mental wellness that came out in the results of this study. Overall, the associations found on this study should be further researched with larger sample size to provide more powerful and reliable statistical analyses and enhance the generalisability of the results.

The insight from this study highlights the need for more research and better involvement of Indigenous peoples and local communities in research and policy-making processes related to matters impacting their daily lives. The local peoples' own perspectives concerning their traditional food systems, its importance, and impact on the health and mental wellness are essential especially in regions balancing the conflicting evidence on those systems, such as Greenland. The importance is further highlighted at the time of sociocultural and environmental changes influencing the lifestyles of Indigenous peoples around the Arctic. Furthermore, utilising the concept of One Health and systems approach when examining the traditional food were found beneficial in the context of this study; applying the food systems approach in research and overall discussions concerning the traditional food of northern Indigenous peoples as well as utilising the One Health approach both enable more holistic viewpoints when aiming to describe and understand such complex topic and further, include local perspectives.

Importantly, acknowledging the importance of local perspectives and Indigenous knowledge could benefit all stakeholders; the engagement of Indigenous peoples has huge potential in terms of traditional knowledge and close interaction with local environment as well as risk communication, mitigation, and adaptation measures (Kuhnlein et al., 2013; Fernández-Llamazares et al., 2019). Traditional knowledge that is passed through generations builds on the lived experience and is based on complex knowledge systems, including information and understanding of the weather and climate conditions, animal distribution and behaviour, the environment and local ecosystems, societal factors, and body condition, and traditional diet (Kuhnlein et al., 2013; AMAP, 2018a). Also, local

communities live in close relationship with the surrounding nature and being in the forefront, they observe and experience the changes in the environment quickly. Developing cooperation between research scientists, policymakers, Indigenous peoples, and local communities could benefit all tremendously. In fact, Greenland stands out as an example of active engagement as local residents of five larger towns and villages have taken part in monitoring the effects and levels of contaminants (AMAP, 2018a). This type of involvement and engagement of Indigenous peoples and local communities should be promoted and applied more broadly concerning issues related to the traditional food systems.

## 7. CONCLUSIONS

This thesis aspired to expand on the conflicting topic of traditional food and health in Greenland by focusing on the local peoples' own perspectives in relation to their traditional food system building on the existing knowledge and providing an additional viewpoint on the topic. The results of this thesis suggest traditional food system to still have an important role in the local community where the level of traditional food consumption and reliance on subsistence activities remains high regardless of the ongoing sociocultural and environmental changes. Additionally, traditional food system seems to contribute to the subjective health and mental wellness of the community members. Neither the concerns over potential health risks nor the discussed health benefits related to traditional food consumption did not come out in the results of this study where traditional food consumption itself, or changes in it, had no significant impact on the subjective health and mental wellness. However, the subsistence activities and related changes had clearer impact; hunting and fishing seemed to support mental wellness, whereas gathering was simultaneously positively associated with feelings of empowerment and inversely associated with SRH, and a decrease in the number of berries and mushrooms had a negative association with mental wellness.

Noteworthy, the study had a small sample size and relied on self-reported estimations related to traditional food consumption and subsistence activities. However, despite the limitations related to the sample size and methodology, these findings provide a new perspective to the conflicting topic of simultaneous health risks and benefits of traditional food system in Greenland. Indeed, the previous studies tend to focus on the more objective measures of health, whereas this study provides insight from the local peoples' own perspectives regarding the role of traditional food system and its impacts on their health and mental wellness. Additionally, this study provides new information concerning the role of gathering and related changes, and their relationship with subjective health and mental wellness; these aspects of traditional food system have had only little attention in previous research. Further research is needed to gain a deeper understanding concerning the local peoples' own perspectives on their traditional food systems, related changes, and how those impact their subjective health and well-being. Moreover, pathways for these perspectives to be heard should

be created and cooperation between scientists, policymakers, Indigenous peoples, and local communities further developed.



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## APPENDICES

### APPENDIX 1. Original study variables

Survey questions	Answer options			
Traditional food systems				
14. Do you eat country food at least one time per week?	Yes	No		
15. What percentage of your diet is country food?	0-100%			
16. Has the amount of country food you eat increased or decreased in the past years?	0-50-100 (decrease – stable – increase)			
17. Can you explain this change?	Open answers			
18. How important is subsistence harvesting for your household?	0-100 (not important – very important)			
19. Do you hunt or fish?	Yes	No		
20. Do you get country food from family members, friends and/or as a donation?	Yes	No		
21. If yes, how often do you receive country food from family members, friends, and/or as a donation?	Once a week Two times per month Once a month Few times a year Once a year			
22. Do you share country food with other households in your community?	Yes	No		
23. Where did the majority of your food come from last week?	The supermarket  The land (including frozen or preserved food) Local shop (brættet) Family members or friends Other (please specify)			
24. Among these, which country food do you consume most in WINTER	Whale	Seal	Birds	
	Reindeer	Muskox	Hare	
	Polar bear	Fish	Other	
25. Among these, which country food do you consume most in SPRING	Whale	Seal	Birds	
	Reindeer	Muskox	Hare	
	Polar bear	Fish	Other	
26. Among these, which country food do you consume most in SUMMER	Whale	Seal	Birds	
	Reindeer	Muskox	Hare	
	Polar bear	Fish	Other	
27. Among these, which country food do you consume most in FALL	Whale	Seal	Birds	
	Reindeer	Muskox	Hare	
	Polar bear	Fish	Other	

28. How do you best preserve the meat or fish that you hunt?						
Freezer	1.	2.	3.	n/a		
Ice storage	1.	2.	3.	n/a		
Dried and smoked	1.	2.	3.	n/a		
29. Do you collect berries, mushrooms, and/or medicinal plants/foods?		Yes		No		
30. If yes, have you seen changes in the number of berries, mushrooms, and/or medicinal plants in your best picking spots?		0-50-100 (decrease – stable – increase)				
<b>Background characteristics</b>						
35. What is your age?		18-24	25-34	35-44		
		45-54	55-64	65 or over		
36. What is your gender?		Female	Male	Other		
37. What is your professional activity?		Public sector				
		Private business				
		Professional hunter/fisherman				
		Unemployed				
		Retired				
		Student				
		Homemaker				
		Other (please specify)				
42. What language do you speak at home?		Greenlandic				
		Danish				
		English				
		Other (please specify)				
<b>Perception of health and subjective well-being</b>						
38. Do you consider yourself as a healthy person?		0-100 (not healthy – very healthy)				
39. How would you assess your:						
Well-being		Very bad	Bad	Ok	Good	Very good
Quality of life		Very bad	Bad	Ok	Good	Very good
Satisfaction with life		Very bad	Bad	Ok	Good	Very good
12. Do you feel empowered to face these [environmental] changes?		No		Somewhat		Yes